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CONSEIL PERMANENT INTERNATIONAL POUR
L'EXPLORATION DE LA MER
CHARLOTTENLUND SLOT — DANEMARK

ANNALES BIOLOGIQUES

VOLUME NO. XI

RÉDIGÉ PAR
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Scheme for the Arrangement of the Material.

I. Review of Investigations and Essential Results.

Each Committee Chairman should here give a summary of the contributions received, i. e., a statement of the nature of the material as well as a short review of the position in the area—including the main results obtained—during the last calendar year (unless otherwise stated). This review should only in exceptional cases exceed 2 pages (about 10,000 units of type). Papers should reach the General Secretary not later than 1. June.

II. Tables and Conclusions.

A. Environment.

1. Strength and direction of currents: especially data collected during spawning seasons.
- 2 a. Temperature and salinity conditions: Tables and/or diagrams including anomalies.
- 2 b. Seasonal temperature variations at selected stations: Data including anomalies.
3. Phosphate concentration, oxygen, etc.: Tables and diagrams to include anomalies.
4. Plankton conditions: Tables and/or diagrams, especially anomalies in distribution of indicator forms, phytoplankton patches, amount of plankton and fat content.
5. Abundance of benthonic food: Data.
6. The main meteorological features of the year: Data especially as to sunlight, rainfall, and direction and force of the wind.

B. The Fish.

For each species in the following order: gadoids (cod, haddock, saithe, others), flatfishes (plaice, dab, flounder, sole, witch, lemon sole, halibut, others), herring, sprat, mackerel, other pelagic fishes, eel, redfish, others.

1. Abundance and distribution of eggs and larvae.
2. Abundance of year-classes: Data derived from experimental hauls.
3. Size- and age-composition of commercial catches or landings.
4. Average length of age-groups: Data from experimental hauls and commercial catches, with standard deviations.
5. Rate of growth: Data from marking experiments and quantitative experimental hauls.
6. Rate of mortality: Data from marking experiments and quantitative experimental hauls.
7. Intensity of fishing: Data as to the fisheries considered in 3, 4, and 8.
8. Quantities landed:—
 - (a) Total catch (weight) of special fisheries.
 - (b) Percentage of large, medium and small.
 - (c) Total number of the various species.
 - (d) Size- and age-composition of commercial catches or landings.

C. Shellfish.

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PREFACE

IN this issue of the *Annales Biologiques* considerable changes have taken place owing to the new arrangement of committees agreed upon at the Council Meeting in Paris, October 1954. There are two area committees less now (Vol. XI) than earlier (Vol. X), as the Distant Northern Seas Committee has replaced the North-Eastern and North-Western Area Sub-Committees, and the Baltic and the Transition Area Committees have been combined in one, the Baltic-Belt Seas Committee. The map overleaf shows the extension and boundaries of the four area committees. Earlier (Vol. X) there were only two subject committees, Herring and Shellfish, now (Vol. XI) three new ones have been added: The Gadoid Fish, The Sardine, and The Scombriform Fish Committees. This volume therefore, comprises contributions from nine committees, as compared with eight earlier.

It is thought that the new arrangement of the *Annales Biologiques* is advantageous, as some general aspects, viz. hydrography, plankton, etc. are surveyed in the reports from area committees, where many important species of fish, as catfish, redfish, and flatfish will also be dealt with. On the other hand, reports on the most important species and families of fishes (and shellfish) will be found concentrated in the subject sections. It is hoped that this arrangement tends to make this publication more convenient for the readers to use.

I should once more wish to underline what I emphasized in my preface to Volume X, last year, that chairmen of committees and all their contributors are kindly asked constantly to bear the following in mind:—

1. The *Annales Biologiques* is intended for, and should be strictly limited to, what is typical for the year in question, as compared with other years, may it concern hydrography, fish stocks, or other features, bearing on fluctuations.

2. Tables and figures should not overlap each other too much, and it should be kept in mind that tables are intended for reference and exact comparison, figures for survey.

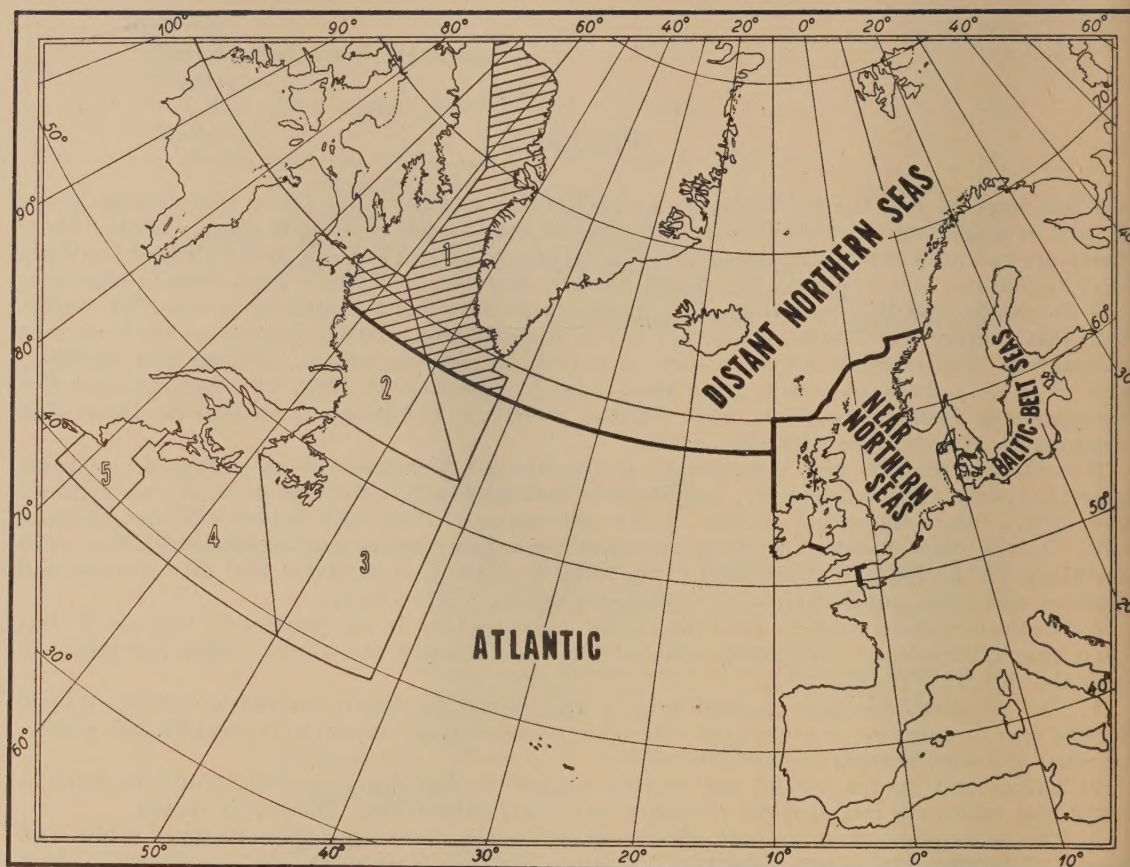
3. The text should be very short, chiefly limited to the necessary explanations of tables and figures. The preparation of a volume of the *Ann. Biol.* is a team work "par excellence", where every title and piece of information must be brought to fit the whole in order to form a general survey of the situation. Consequently it is not possible to make major corrections or amendments of the text when a volume has reached an advanced stage of preparation, and the question of reprints to individual authors is practically impossible to deal with.

4. One of our problems are the illustrations which should be delivered ready for reproduction in clear and clean design. It is particularly necessary that any lettering should appear in adequate size to fit the figure in its final reduced size.

5. Please, read the second cover page about the general arrangement of the material printed in the *Annales Biologiques*.

I wish finally to thank the chairmen and all the contributors for their kind co-operation and last but not least I should like to thank Mrs. H. HARDER and Miss M. HÄNSCHELL of the Central Office for their invaluable assistance.

ÁRNI FRÍÐRIKSSON.



Map showing the areas covered by the new Area Committees of the I.C.E.S., and the area of Panel 1 of I.C.N.A.F. (hatched) which is also within the boundary of the Distant Northern Seas Committee.

The new boundaries of Area Committees are defined as follows:—

Distant Northern Seas Committee.

The area of the North Atlantic north of the latitude of Rockall and thence north of the northern boundaries of the Near Northern Seas area.

Near Northern Seas Committee.

On the south and east by the coastline of the European mainland and the 1946 Fisheries Convention boundary to the north of the Belts and the Sound. On the north from the Norwegian coast along Latitude 64°N. until it reaches the 1000 m. contour thereafter along this contour to Latitude 60°. On the west from Latitude 60°N. southward along

Longitude 10°W. to the coast of Ireland, and along the north and east coasts of Ireland to Carnsore Point, thence in a straight line to Cape St. David along the English south and west coasts to Longitude 2°W. and from this intersection along 2°W. to Cape La Hague.

Atlantic Committee.

Between the latitudes of Rockall and the Equator and west of the western limits of the Near Northern Seas area and the European and African coast lines.

Baltic-Belt Seas Committee.

The Baltic and Belt Seas south and east of the 1946 Fisheries Convention boundary, defined by lines drawn from Hasenore Head to Griben Point, from Korshage to Spodsbjerg and from Gilbjerg Head to the Kullen.

Distant Northern Seas.

INTRODUCTION

Contributions to this report have been received from:—

Denmark:
Mr. K. P. ANDERSEN
Mr. FREDE HERMANN
Mr. JENS SMED

Germany:
Dr. C. H. BRANDES
Dr. A. KOTTHAUS
Dr. G. KREFFT
Dr. ARNO MEYER

Iceland:
Mr. UNSTEINN STEFÁNSSON
Mr. A. SIGURÐSSON

Scotland:
Dr. J. H. FRASER
Mr. A. D. MCINTYRE
Mr. J. H. STEELE

Norway:
Mr. O. J. ØSTVEDT

The area »Distant Northern Seas« comprises the two former areas, North-Eastern Area and North-Western Area, but all contributions on gadoid fish, herring, sprat, etc., and shellfish in distant northern seas, will in future be included in the special reports on these fish.

The principal fish species which will be covered in the contributions to this area report in future are redfish (=Norway haddock), halibut, lemon sole, and plaice; a few other flatfish (witch, megrim, and dab), as well as catfish, dogfish, skates, and rays will also be touched on.

Of environmental factors the hydrographic and to a lesser degree the planktonic factors have been dealt with at some length in the North-Western Area and the North-Eastern Area reports; up to the present, however, very little attention has been paid to benthonic food; it therefore seems desirable that the biotic environment should be given more consideration in the future, and that phosphate concentration and plankton production in all areas be reported upon. As both short- and long-

period climatic changes in the sea have been found to depend in a high degree on certain meteorological factors (direction and force of the wind, sunlight, etc.) it seems appropriate to include in the area reports each year contributions dealing with the more important meteorological features.

Environment.

The hydrography of the western part of the Distant Northern Seas area is fairly well covered, at any rate for the summer half of the year; conditions in the Faroe-Shetland Channel, in waters between the Faroes and eastern Iceland, to the north of Iceland, and between north-eastern Iceland and Jan Mayen, as well as those from the south of Iceland to East Greenland (including the greater part of the Denmark Strait) in Davis Strait between Disko Island and Hamilton Inlet, and on a line from Cape Farewell to the entrance of the English Channel have been studied by several research vessels. Unfortunately no information is available from the easternmost part of the area, and from this important region no information has been received since 1949 and it has not been possible for the readers of *Annales Biologiques* to follow the changes which might have occurred there. It is hoped, however, that this deficiency will not continue.

The routine study of monthly anomalies of surface temperature in the central and western part of the area has shown that positive anomalies still predominate, though with lower values than in 1953.

The detailed hydrographic studies of the several sub-areas show that in general the changes which have occurred are relatively slight, as compared with conditions in 1953 and preceding years. An exception may be made, however, of the influx of Atlantic waters into the coastal area north of Iceland, where this water appeared unusually early, viz., in April. It should be emphasized that for the first time a routine hydrographic section was carried out from Cape Farewell to Ireland, across the main path of entry of Atlantic water to northern regions. A detailed hydrographic survey was carried out by Scotland in connexion with halibut researches mainly on the eastern side of Denmark Strait, and included studies of chlorophyll, phosphate, and dry weight. The routine sections were operated in Davis Strait, together with an additional section from Cape Farewell to Hamilton Inlet; these show *inter alia*, that the temperature of the upper water layers in Davis Strait was about 1° lower in July 1954 than in the same month in 1953.

The progress of the hydrographical work in the western part of the distant northern waters is evident, and the present study of the main currents should make major alterations of

importance to the fishery to be discovered if they occur.

Zooplankton researches this year are reported only by Scotland. The Faroe area was sampled in April, June, July, and October; the area between Rockall and Reykjanes in May; and Denmark Strait and Faxe Bay in May and June. The report shows several interesting features and findings of some rare fish are recorded. No information is available for Davis Strait, nor for the Norwegian Sea and the waters farther east.

The Fish.

For the year 1954 this part of the report for distant northern waters is very short, owing to the new arrangement of committees. Reports are given on size and age-group composition of the plaice in Faxe Bay, on a new fishery for redfish and trade ling in Faroe waters, and on the marking of spotted catfish in the Barents Sea; in addition, a valuable faunistic list of exotic fish is given.

The marking experiments on spotted catfish in the Barents Sea show that in spring and summer this fish makes a westward, contranatal migration to the spawning grounds, and returns in autumn and winter.

Å. VEDEL TÅNING.

ENVIRONMENT

Hydrography.

Monthly Anomalies of the Surface Temperature in Areas of the Northern North Atlantic in 1954.

On the basis of data collected in 1954 by the Danish Meteorological Institute from Danish and Icelandic ships in the northern North Atlantic anomalies of surface temperature have been evaluated for each month and each 1°-square, using RYDER's grand monthly means for the period 1876—1915 as standards. These anomalies were then averaged over the areas indicated in Figure 1.

The results are given in Table 1 where monthly anomalies are recorded together with the numbers of observations on which they are based. In the last column of the table the monthly anomalies for each area have been averaged over the year.

Table 1 shows that positive anomalies still predominate. In fact, of the yearly anomalies given in the last column of Table 1, only that for area N is negative. The distribution of the yearly anomalies over the whole region is seen from Figure 2. The figure shows that the highest anomalies are found in the northern part of the region, especially in the areas G and I surrounding Iceland.

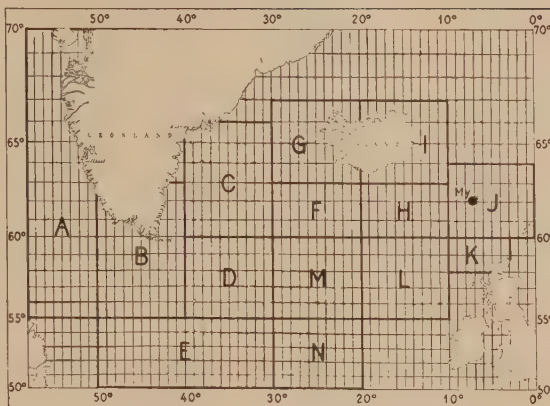


Figure 1. Location of areas A to N and of station My.

Although positive anomalies predominate also in 1954, the tendency from 1953 to 1954 is towards lower values. In one area only (area G) the yearly anomaly is higher in 1954 than in 1953. The average of the yearly anomalies given in the last column of Table 1 is 0.4°C. against 0.7°C. in 1953. The geographical distribution of the temperature variation from 1953 to 1954 is seen from Figure 3.

Table 2 gives grand monthly means of the

Table 1. Monthly Anomalies ($\Delta^{\circ}\text{C.}$) and Numbers (n) of Observations of the Surface Temperature in the Areas A-N (see Figure 1) during 1954.

Area	Jan. Δ	Jan. n	Febr. Δ	Febr. n	March Δ	March n	April Δ	April n	May Δ	May n	June Δ	June n	July Δ	July n	August Δ	August n	Sept. Δ	Sept. n	Oct. Δ	Oct. n	Nov. Δ	Nov. n	Dec. Δ	Dec. n	Aver. Δ -val.
A.....	—	—	—	—	—	—	-0.3	18	0.7	109	0.9	174	0.4	256	1.3	210	1.0	129	0.7	92	-0.3	9	—	—	0.6
B.....	—	—	—	—	-1.1	24	-0.5	54	0.5	140	0.7	107	0.6	122	1.2	122	1.1	100	-0.2	87	-0.7	48	0.6	3	0.2
C.....	—	—	—	—	0.5	15	0.4	31	0.1	55	0.9	52	1.0	39	0.9	82	0.6	75	-0.2	63	0.5	9	0.5	1	0.5
D.....	1.5	1	-1.6	2	-0.2	42	0.1	75	0.1	96	0.6	70	0.6	38	0.9	43	-0.2	36	-0.5	25	-0.8	27	0.3	13	0.1
E.....	-1.0	9	-0.1	21	-0.1	47	-0.1	32	0.3	41	0.5	32	0.8	8	1.1	37	0.3	52	-0.6	46	-0.3	56	0.8	50	0.1
F.....	-0.9	5	—	—	0.6	39	0.3	96	0.5	116	1.0	80	0.2	67	0.4	90	0.0	58	-0.1	72	-0.9	26	-0.6	23	0.0
G.....	1.3	6	1.9	17	1.8	12	1.4	26	0.4	12	1.7	24	0.5	20	1.0	10	1.3	7	0.9	27	0.4	11	0.0	6	1.0
H.....	1.1	55	0.6	65	0.9	73	0.8	111	0.7	117	0.8	135	0.0	105	0.0	142	0.1	98	-0.4	113	0.0	45	0.3	41	0.4
I.....	2.0	18	0.5	9	1.5	9	1.3	10	1.7	12	0.8	27	0.9	18	1.5	12	1.2	6	-0.1	3	1.0	5	1.9	5	1.2
J.....	1.1	62	0.8	43	0.9	57	0.8	73	1.0	78	0.6	131	0.4	93	0.2	117	0.4	60	0.0	72	0.2	36	0.4	38	0.6
K.....	1.1	36	0.8	33	0.4	44	0.7	41	0.7	58	0.4	56	-0.2	43	0.1	67	-0.3	57	0.0	64	0.3	53	0.4	62	0.4
L.....	1.4	7	0.4	21	0.3	27	0.2	27	0.6	21	0.3	23	-0.8	14	-0.4	28	-0.2	39	0.1	43	-0.4	51	0.3	56	0.2
M.....	1.2	11	0.1	26	-0.1	27	0.5	18	0.5	22	0.2	9	0.0	19	-0.4	30	-0.1	38	-0.4	51	-0.6	61	0.0	50	0.1
N.....	—	—	-0.6	2	-0.5	5	0.8	10	0.8	7	-0.2	13	0.3	6	0.7	10	-1.2	3	-0.7	1	-1.0	3	—	—	-0.2

Table 2. Grand Monthly Means of the Surface Temperature ($^{\circ}\text{C.}$) at Myggenæs, Faroes (My in Figure 1), during the Period 1914—50 and Deviations for 1954 from these Means.

	Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Means 1914—50	6.3	6.0	5.9	6.3	7.1	8.2	9.3	9.8	9.7	9.1	7.9	7.0
Deviations 1954	0.6	0.3	0.5	0.5	0.6	0.4	0.1	0.0	0.2	-0.4	(0.2)	-0.3

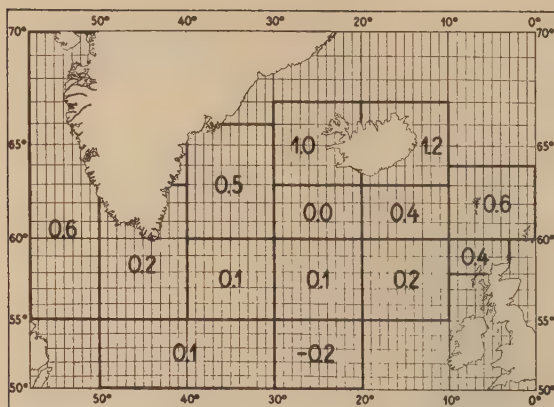


Figure 2. Yearly anomalies of surface temperature ($^{\circ}\text{C}.$) for 1954.

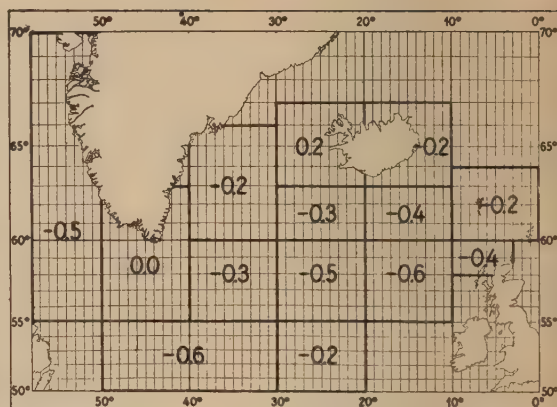


Figure 3. Variation of surface temperature ($^{\circ}\text{C}.$) from 1953 to 1954.

surface temperature at Myggenæs, Faroes (station My in Figure 1), during the period 1914–50, together with deviations for 1954

from these means, based on data received from the Danish Meteorological Institute. The value for November 1954 is given in brackets because it is based on 3 observations only, and all of them from the first week of the month. The mean temperature for 1954 is $0.2^{\circ}\text{C}.$

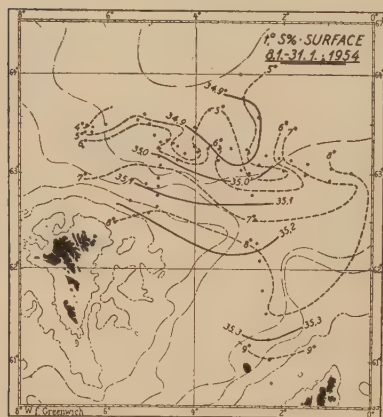




Figure 7.

lower than the mean temperature for 1953—in agreement with the result found above that the temperature in area J has fallen 0.2°C .

For placing data at my disposal I am greatly indebted to Messrs. I. SESTOFT and H. THOMSEN of the Danish Meteorological Institute.

JENS SMED.

Hydrographic Conditions in the Southern Part of the Norwegian Sea, 1954.

The important herring area north of the Faroes was this year investigated during January, June, and July. In January the fisheries inspection ship "Thetis" and the M/C "Jacob Hendriksen" and M/C "Kurborg" worked under the leadership of Commander BONNEK and Mag. JOENSEN, respectively. The principal investigations were as usual made in June by R/V "Dana" under the leadership of Dr. E. BERTELSEN. M/S "Thetis" also took

the July observations and again Commander BONNEK was in charge.

Figures 4—11 demonstrate the distribution of temperature and salinity at various depths in the three months. The eastern tongue of the East Icelandic Current is clearly recognized and a comparison with the observations from the three months indicates that the extension of the tongue was least in June.

A rough comparison of June 1954 and June 1953 gives a striking similarity in the geographical course of the border between the Atlantic water and the subarctic water, but a comparison in detail shows certain differences between the two years. As regards temperature, the surface layers this year were warmer in the eastern part than in 1953, but it was the opposite in the western part of the area. There also was a difference in salinity as the cold surface water had a lower salinity in 1954, whereas the Atlantic water had about the same salinity in the two years.

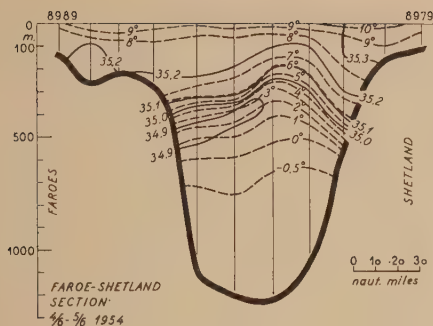


Figure 12.

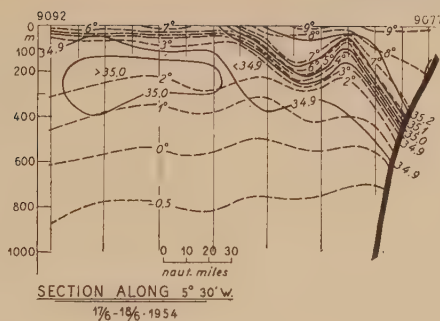


Figure 13.

These features are further illustrated in Figure 12, which shows a section along $5^{\circ}30'$. In the cold part of this section water masses of salinity greater than $35.0^{\circ}/_{00}$ are found. The same thing was true last year, but the saline water masses were found nearer to the surface in 1953.

Figure 13 shows a section in the Faroe-Shetland Channel. The net transport as determined by dynamical calculations was $3.0 \text{ km}^3/\text{hour}$. (Zero-level: bottom for depths less than 800 m. and the isobaric surface at 800 m. for depths greater than 800 m.). This is very low and very different from June 1953 with a net transport of about $16 \text{ km}^3/\text{hour}$, but rather similar to the transport of August 1953, which was $5 \text{ km}^3/\text{hour}$.

As regards temperatures in the Faroe-Shetland Channel the surface layers and deep western water masses were about 1° warmer in 1954 than in 1953, whereas the deep eastern water masses were colder.

The salinity of the surface layers (0—30 m.) and the deep water (600—1200 m.) was about the same in the two years, but the middle layers were less saline in 1954.

A difference in concentration of phosphate was also found, but only for the eastern part of the area, where the surface water was poor in phosphate in 1954 compared with 1953.

K. P. ANDERSEN.

Hydrographic Conditions North and North-East of Iceland, 1954.

As in the preceding years the Icelandic investigations were concentrated on the herring area north of Iceland and in the waters between NE. Iceland and Jan Mayen. These observations were carried out from the Icelandic research vessel "Ægir".

The majority of the hydrographic material was collected in June, BT stations were worked during the cruises in July and early August, and in the latter half of August the observations were repeated in the region between the north coast and 69°N . Besides this, monthly surveys were made of the section off Siglufjörður (Siglunes) throughout the year.

In June the ice limit was found to be about 90 miles off the north-west coast of Iceland, as compared with only 30 miles at the same time last year. Later during the summer the position of the ice border was found to be somewhat variable and at times it moved closer to the shore.

In the section off Kögur, on the north-west coast (Figure 14 a), the temperatures were in June somewhat higher than ordinarily observed for that time of the year. The amount of polar water was distinctly less than has been found in most of the preceding years, as indicated by the relatively high salinity values of the surface layers in the northernmost part of the section, where the conditions resembled closely those found 30.—31. July 1950. The core of the arctic intermediate water was, however, found at a higher level (300—400 m.). Dynamical calculations of this section indicated abnormally weak current and small transport to the south-west outside the shelf.

The influx of Atlantic water to the north Icelandic coastal area began unusually early in 1954, in April already. In May Atlantic water ($S = 35.0^{\circ}/_{00}$) was observed in the section off Siglufjörður, and in June it had extended all the way east to Langanes (Figure 16). At that time the Atlantic influence was decidedly greater off Siglufjörður (Figure 15 a) than at the same date in 1953. Thus the salinity was distinctly higher in 1954, the 4° -isotherm was found at 200—300 metres depth, where the 3° -isotherm

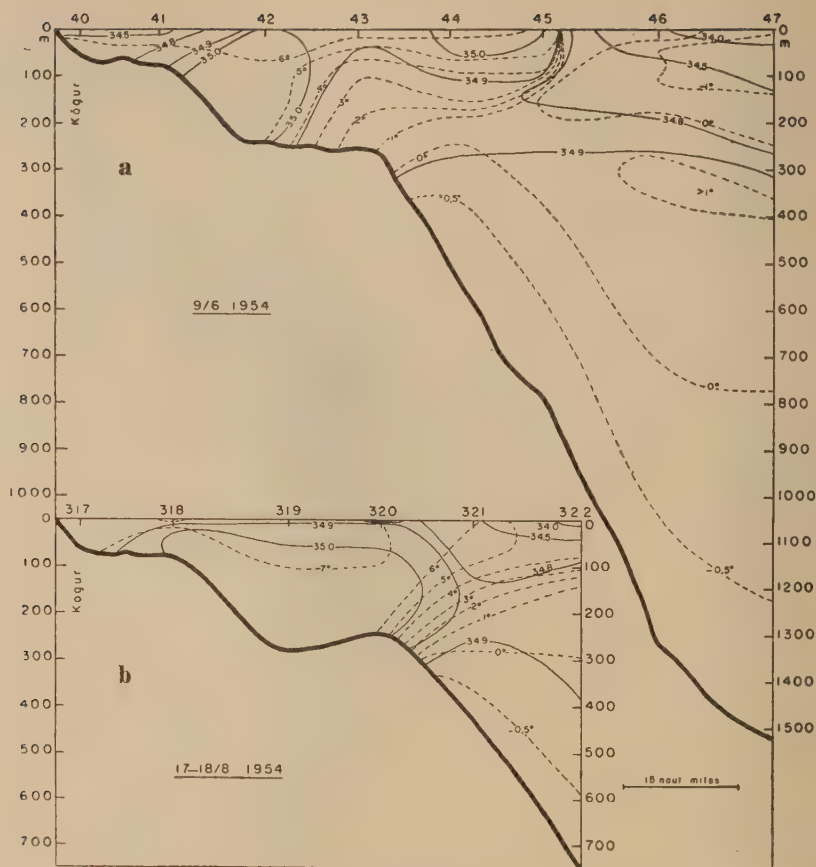


Figure 14. Section off Kögur, a in June, b in August 1954.

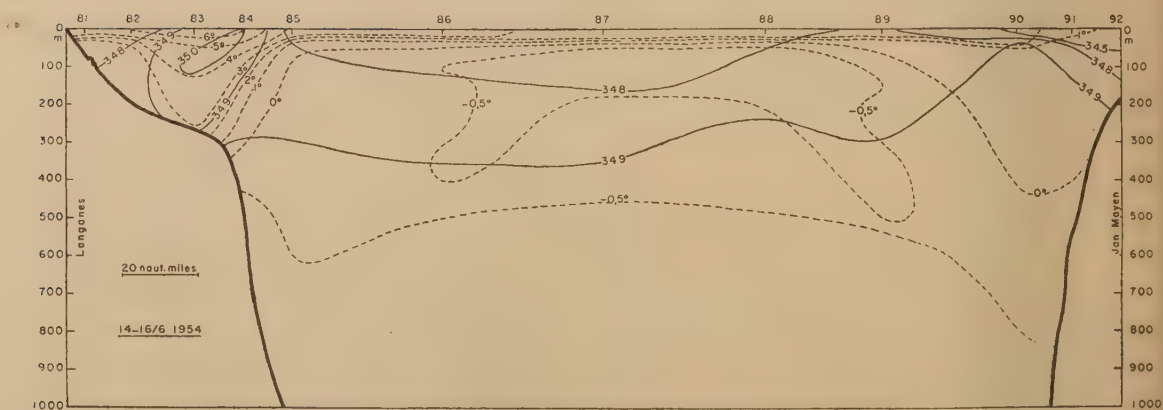


Figure 16. Section between Langanes and Jan Mayen in June 1954.

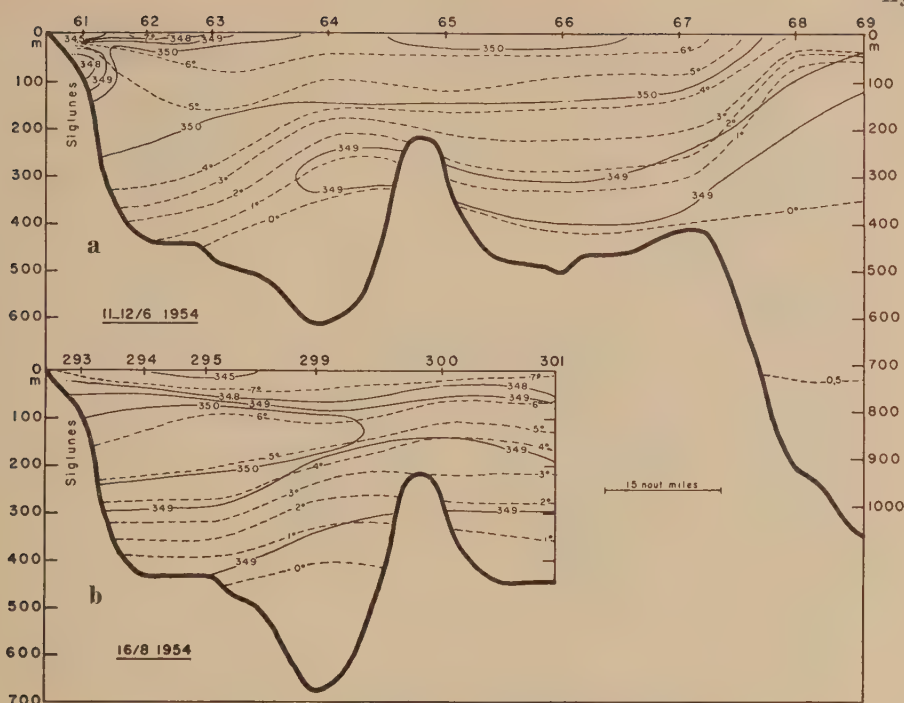


Figure 15. Section off Siglunes, a in June, b in August 1954.

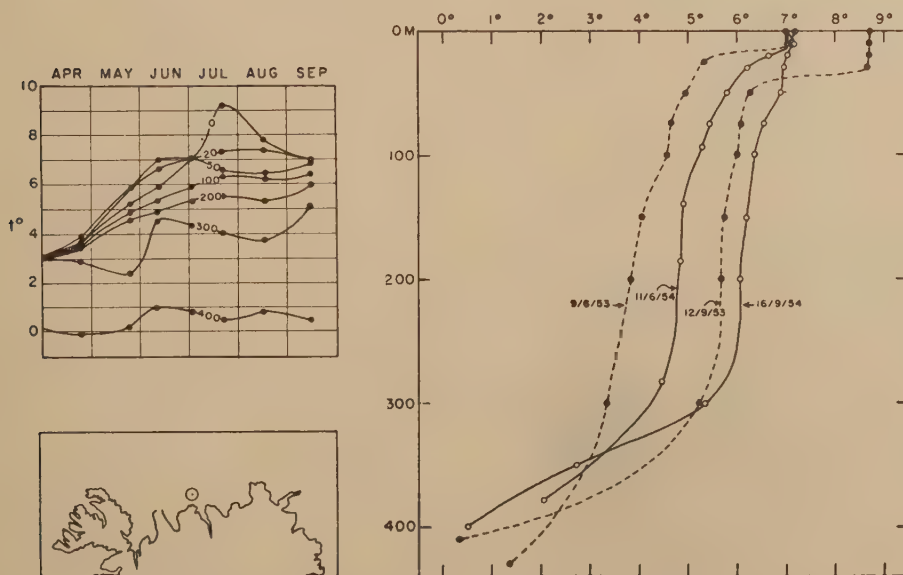


Figure 17. Variations in temperature at Siglunes station II.
Left on top: Changes in temperature at various depths from April to September.
Right: Variations in temperature with depth in June and September 1953 and 1954.

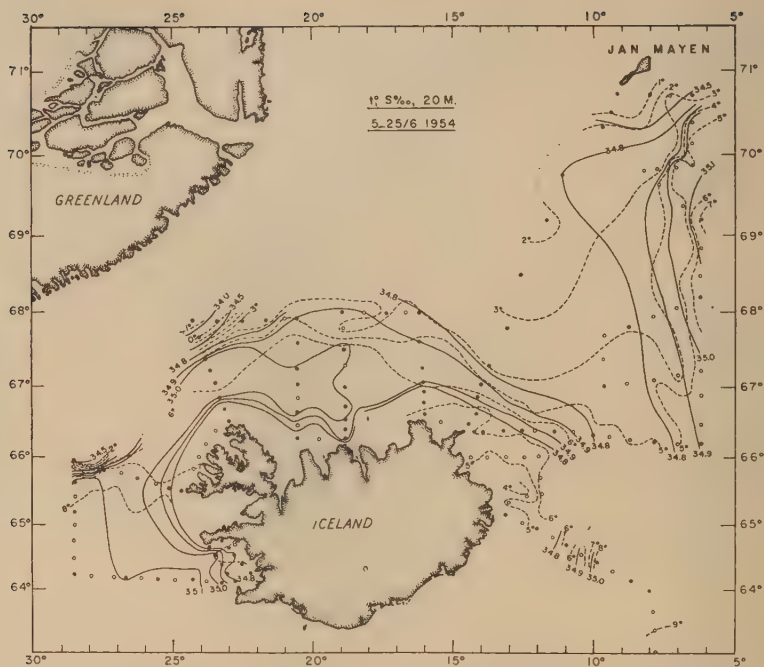


Figure 18. Temperature and salinity, 20 metres. The dots show hydrographic stations, the circles BT stations.

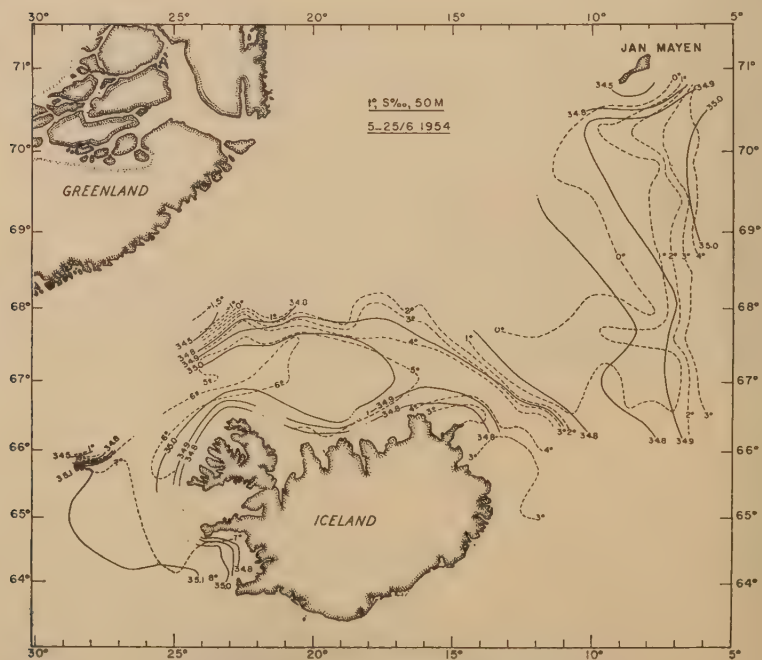


Figure 19. Temperature and salinity, 50 metres.

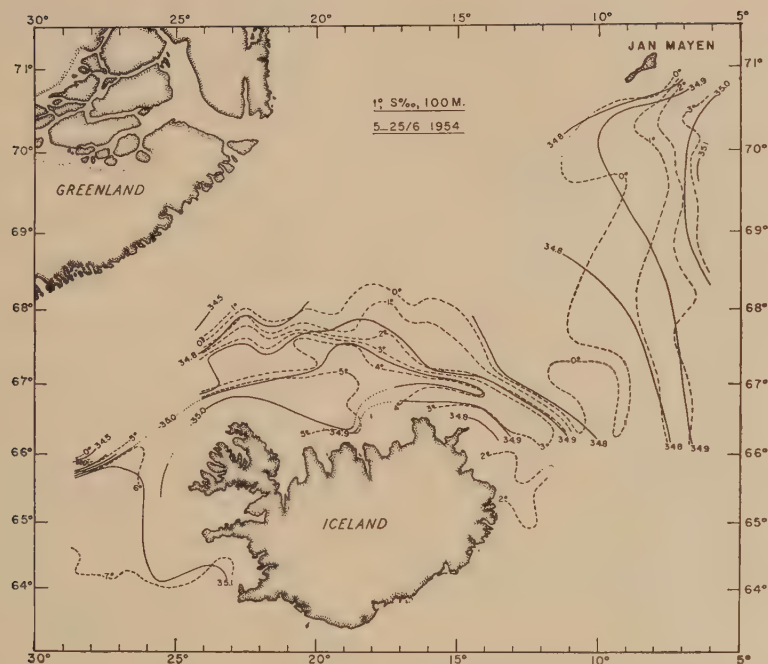


Figure 20. Temperature and salinity, 100 metres.

was found in 1953, and the 5°-isotherm which that year was close to the surface, here appeared near 100 metres. However, the surface temperature was similar or even lower in 1954. Because of the high temperature in the subsurface layers but relatively low surface temperature, a sharp thermocline was not formed at 25—30 metres depth, and this holds true for the other parts of the coastal area (Figures 14 and 16). In this respect there was a marked difference from previous year.

The unusual extension of Atlantic water in the coastal area in June is further illustrated by Figures 18—20, showing the horizontal distribution of temperature and salinity at various depths. In 50 and 100 metres the hydrographic features are comparable to what they were one month later in 1948 and 1951, and in the eastern part of the area distinctly warmer than in August 1949.

Outside the coastal area the situation resembled rather closely that of 1953. Thus the tongue of cold water between Langanes and Jan Mayen was similar in both years with regard to temperature and position. Near the Jan Mayen bank, however, the temperature in the surface layers was slightly lower in

1954 due to the nearness of the ice. East of Langanes the main features were also similar to what they were in 1953, but because of higher temperatures in the Icelandic coastal area in 1954, the cold tongue was more sharply defined on the west side. In the whole oceanic area between NE. Iceland and Jan Mayen a sharp thermocline was apparent as usual at 25—30 metres depth.

For the rest of the summer similar conditions prevailed in the Icelandic coastal area (Figures 14 b and 15 b). This is also clearly seen on Figure 17 which demonstrates the variations in temperature at Siglufjörður station II, the position of which is shown on the inset diagram, from April to September. The variations are shown for several depths down to 400 metres. None of the observations during the summer months indicate that a definite thermocline was formed. The greatest temperature fall in the surface layers is found between 0 and 20 m. in late July, but between 20 and 50 m. the temperature fall is at all times only very slight. How different the temperature structure was in 1953 is indicated by the diagram on Fig. 17 where the variations in temperature with depth in June and September at this same station are

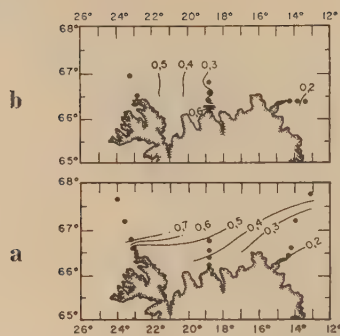


Figure 21. Concentration of inorganic phosphates, at 20 m., $\mu\text{g. at./l.}$, a in June, b in August.

compared for the two years. In the subsurface layers the temperature has obviously been distinctly higher in 1954, but most characteristic is the difference in the surface layers where a sharp thermocline was observed in 1953, but practically nonexistent in 1954. The absence of a definite thermocline was probably caused by two factors, viz. weather conditions (NE. winds were prevailing and the air temperature low) and, as mentioned before, relatively high temperatures at subsurface depths due to the strong and early influx of Atlantic water.

The supply of nutrients in the surface layers was relatively rich both in June and August, as indicated by the analyses of inorganic phosphates (Figure 21 a and b). This was to be expected, as no sharp thermocline was formed and the conditions for vertical mixing therefore favourable. The phosphate values in August are distinctly higher than those found in late July 1948¹⁾ and in August 1950. The Atlantic water seems to be richer in phosphate than the arctic water, but the main reason for the lower values in the eastern part of the area is probably the greater stability of the water in that region.

UNNSTEINN STEFÁNSSON.

Sections Faroes to East Greenland and Cape Farewell to West Ireland.

Two transatlantic sections were worked from R/V "Dana", the section along 62°N. from the Faroes to East Greenland from 29. June to 5. July (Figure 23) and from Cape Farewell to West Ireland from 22. to 30. August (Figure 24). Due to strong gales the

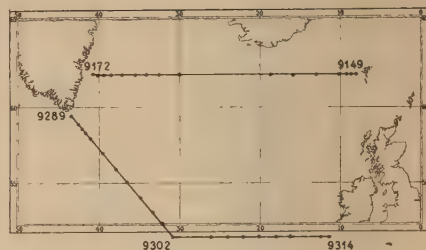


Figure 22. Location of the sections Figures 23 and 24.

middle part of the 62°N. section could not be completed.

In the eastern part of the 62° section the warm atlantic water, with temperatures above 8° C., was present in greater thickness than in the three previous years. In the Irminger Sea, west of the Reykjanes Ridge only small quantities of Atlantic water were found. The amount of Atlantic water in this area seems to have been decreasing since 1952.

In the section from Cape Farewell to Ireland the Irminger Current with salinities above 35⁰/₀₀ was located off the slope of the Greenland shelf. Below and south-east of the Irminger Current we meet the nearly homogenous water, with temperatures between 3° and 4°, of same characteristics as the water masses in the middle part of the Labrador Sea. The boundary to the "Gulf Stream" system was found between stations 9301 and 9302 and was very sharp. The strong inclination of the isotherms and isohalines indicates that strong north-going currents are found at two positions. The westernmost, which is supposed to be the origin of the Irminger Current, is found at longitude 31°W. and the easternmost from longitude 22°W. and eastwards is supposed to be the origin of the Faroe-Shetland current.

FREDE HERMANN.

Hydro-Biological Conditions in the Denmark Strait, May 1954.

In connexion with halibut investigations, the Scottish fishery research vessel "Scotia" carried out a hydro-biological survey in the Denmark Strait in the second half of May 1954.

The station positions are shown in Figure 25. At all stations temperatures and salinities were taken at surface (Fig. 25) and at bottom (Figure 26). At selected stations (indicated as half-black circles in Figure 25) full serial

¹⁾ "Dana", *Bulletin Hydrographique*, 1948, pp. 72-73.

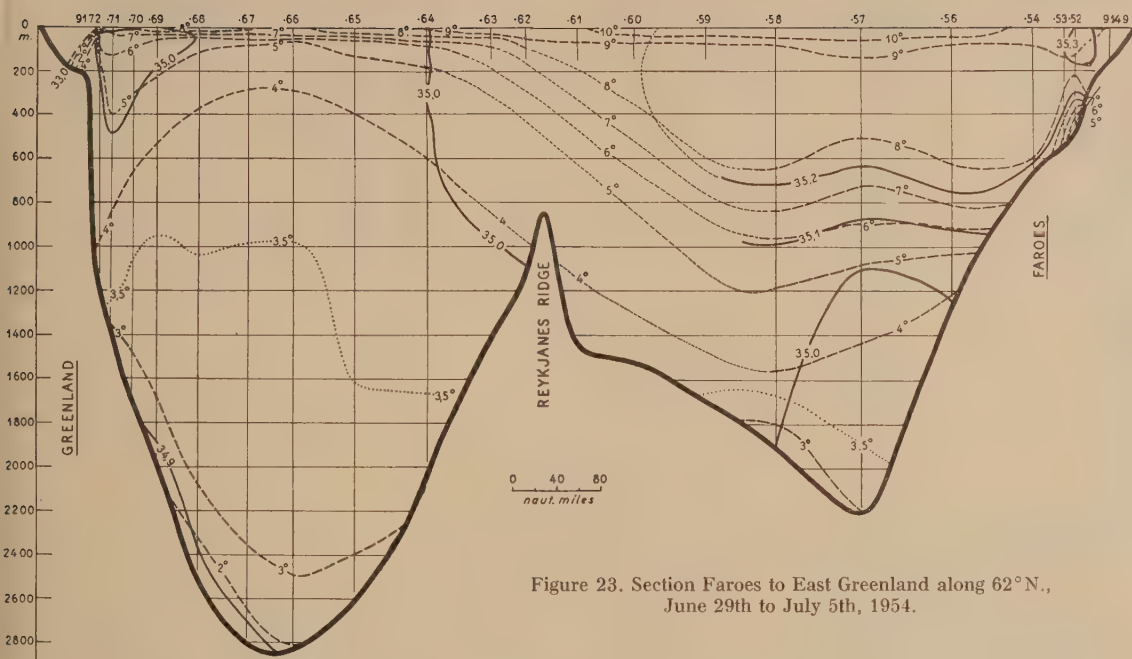


Figure 23. Section Faroes to East Greenland along 62°N.,
June 29th to July 5th, 1954.

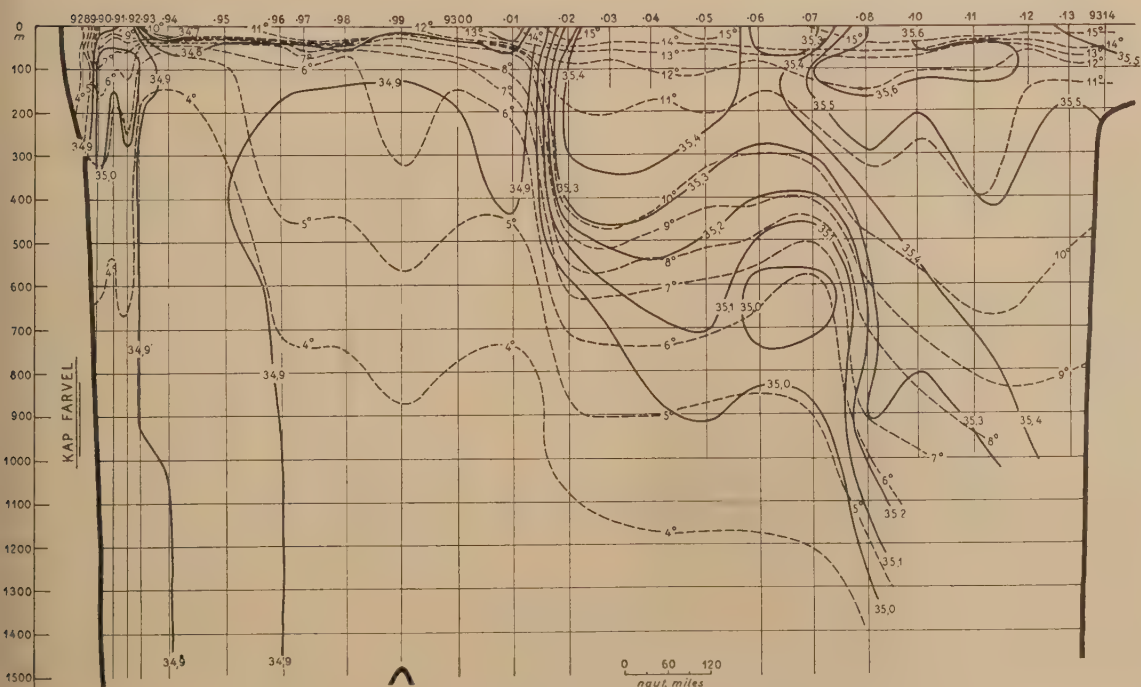


Figure 24. Section Cape Farewell to Ireland, August 22nd to 30th, 1954.

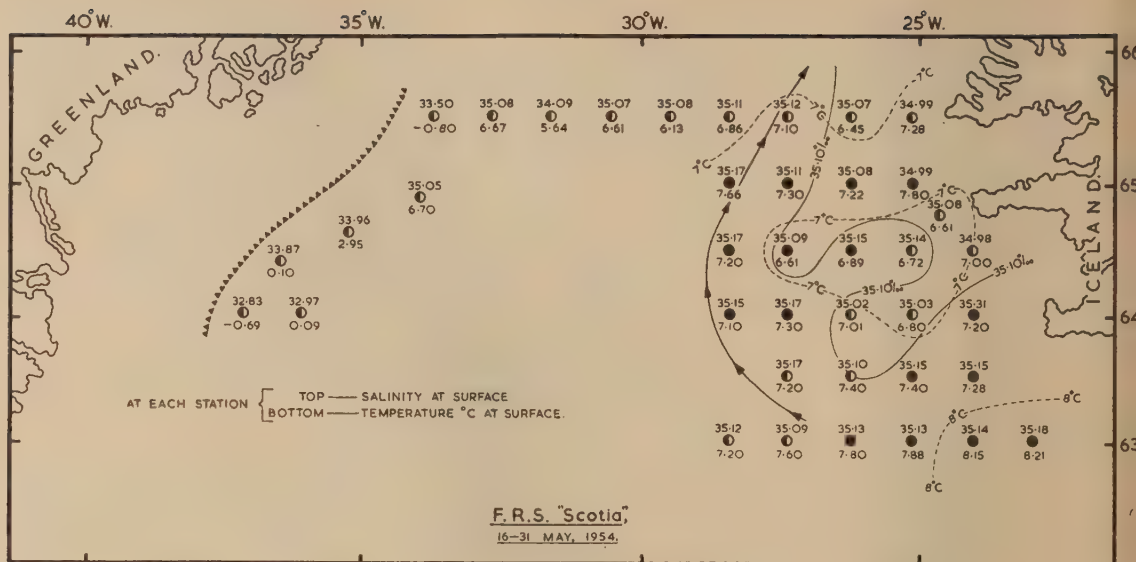


Figure 25.

hydrographic data were collected. The limit of ice off the Greenland coast is shown.

The Irminger Current brings water of comparatively high temperature and salinity into the area from the SE. over the Reykjanes Ridge, and from Figure 25 it can be seen that high surface temperatures and salinities lie in the west of the main grid. Thus it is likely that

the main stream crosses the south-west corner of the grid and that a branch, shown by arrows, passes north through the Denmark Strait.

Dynamic calculations provide measures of the relative velocities and where the current overlies still water an absolute value can be given. The full hydrography stations in the south were arranged at right angles to each

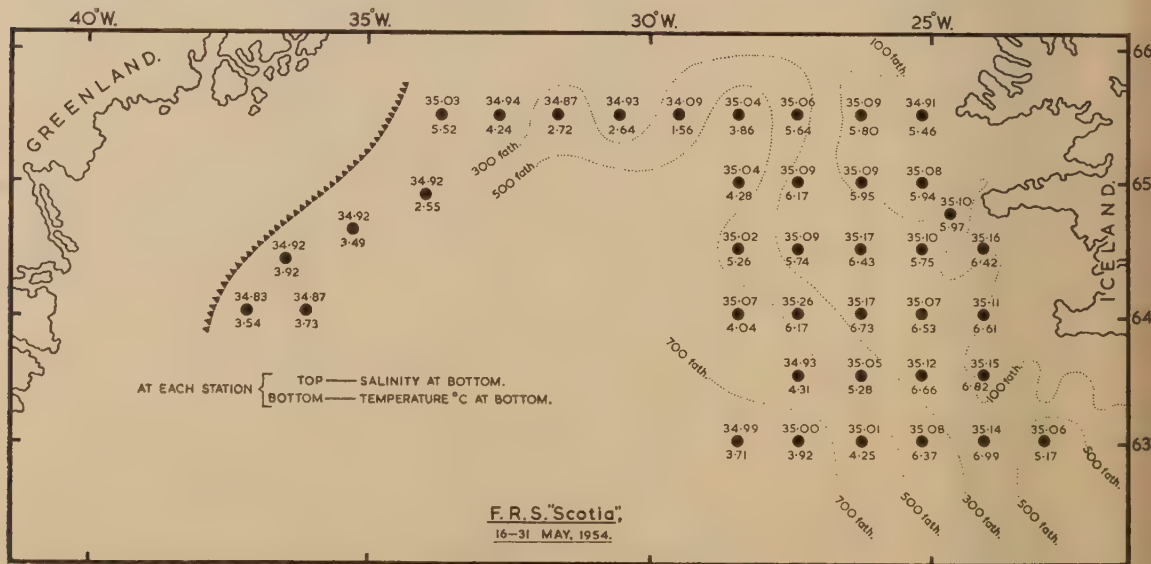


Figure 26.



Figure 29. Temperature distribution at 50 metres and location of sections, July 1954.



Figure 30. Distribution of phosphate at 20 metres, July 1954.

the slope. There will, of course, be small intrusions of warm water towards the coast, but these will not provide a regular flow into Faxa Bay.

At the western end of the northern section (shown in Figure 27) where the last station was near the ice-edge, there was a significant velocity gradient, indicating a mean southerly surface velocity of 1.5 miles per day between the last two stations.

At all stations on the survey, samples for chlorophyll and phosphate were taken at 10

metres, and the Hensen net (hauled vertically from 150 m. to surface) was used for dry weight estimations of the plankton. The calculated values are shown in Figure 28. The time of survey corresponds to the beginning of the spring phytoplankton outburst, and it can be seen that this is controlled by the stability of the water. The stations at which production has started are those where there is less saline water at the surface—due to run-off near the Icelandic coast, and melting ice on the west side.

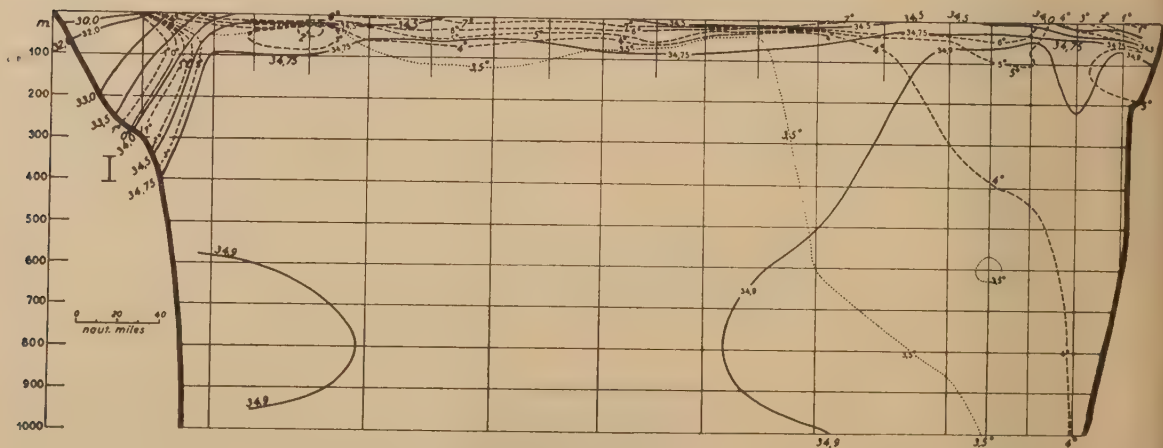


Figure 31. Section I: Cape Farewell to Hamilton Inlet, 6. to 9. July 1954.

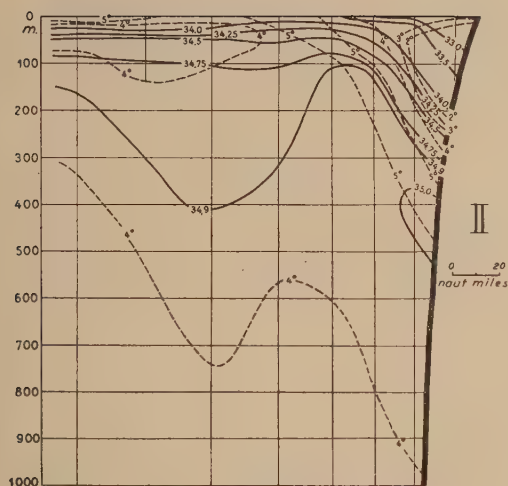


Figure 32. Section II: off Frederikshåb, 11. to 12. July 1954.

At each station three 1 m. silk townets of No. 16 mesh were towed for $1\frac{1}{4}$ hours between 550 m. and surface, or, in shallower areas, between bottom and surface. No halibut eggs or larvae were found in the collections, although the grid covered grounds where ripe halibut had been reported by commercial vessels at the beginning of May.

A. D. McINTYRE, J. H. STEELE.

Hydrographic Conditions in the Eastern Part of Labrador Sea and Davis Strait, 1954.

The hydrographic stations worked by the Danish R/V "Dana" during July 1954 are shown on Figure 29.

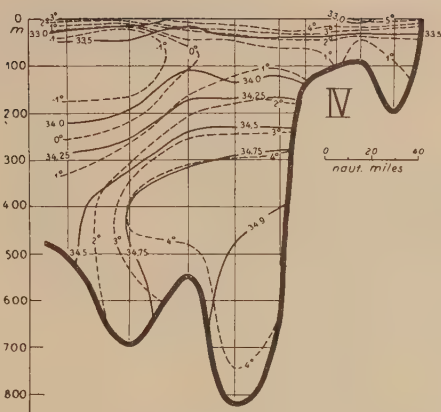


Figure 34. Section IV: across Lille Hellefiske Bank, 22. to 24. July 1954.

The temperature distribution as given in Figure 29 shows that the conditions this year were about normal in July. The arctic component of the West Greenland Current is found nearest the coast, but its water masses were not very cold. The core of the warm Irminger Current is found off the slope of the banks. North of the Fylla Bank section (III) it is mainly found as an undercurrent. Between section III and IV a part of the current turns westward where it joins the Baffin Land Polar Current.

Phosphate determinations were carried out in the upper 100 metres. Figure 30 shows the distribution of phosphate at 20 metres. High concentrations of phosphate were found in two areas, one maximum was situated off the slope of the south-west Greenland banks nearly

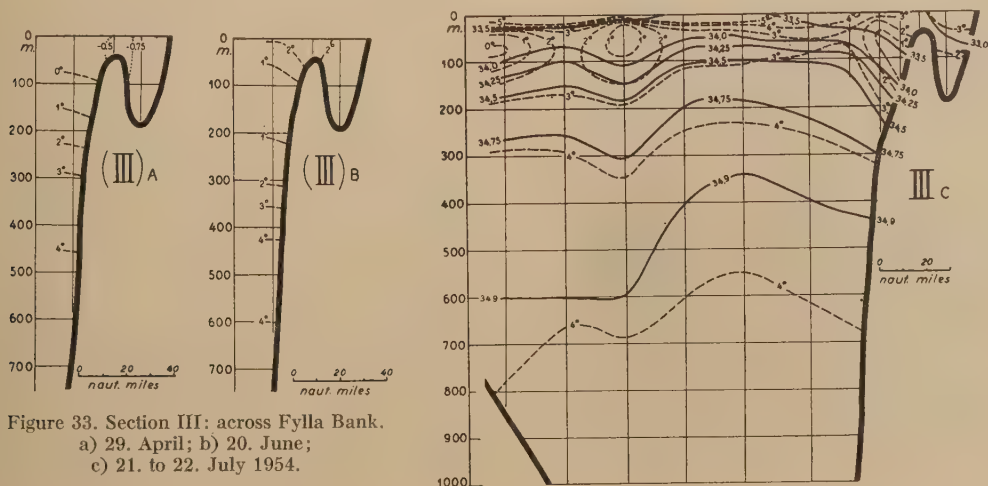


Figure 33. Section III: across Fylla Bank.
a) 29. April; b) 20. June;
c) 21. to 22. July 1954.

66°15'N. and between 24°W. and 29°W., with a westerly line of stations from the north-west corner of this square to 34°W. and south-west from there to 64°N., 37°W., of 9 stations.

The Chaetognatha were represented by *Sagitta maxima* and *Eukrohnia hamata* over the entire area, and although these were not usually abundant they were richest at the western side of the square of stations. *S. elegans arctica* was present on the western and south-western lines of stations and also at the north-east corner of the square but not over the rest of the survey. Euphausiids were moderately abundant, consisting mainly of *Thysanoessa longicaudata* and *Meganyctiphanes norvegica* with lesser numbers of *Th. inermis*. *Thysanopoda acutifrons* was found at both the south-west and north-west corners of the square and *Nematobrachion boopis* and *Stylocheiron elongatum* were also found at the north-west corner. *Calanus finmarchicus* was only poorly represented, often being very scarce indeed; *Euchaeta norvegica* was the dominant copepod with the boreal species *Calanus hyperboreus* and *Metridia longa*. At almost every station except the extreme north-west of the survey the cosmopolitan Atlantic species *Rhinocalanus nasutus* and *Eucalanus elongatus* were found. Other interesting crustacea were the amphipods *Thaumatops fabricii* at 64°30'N. 28°25'W., and *Onesimus leucopis*, *Amphithopsis longicaudata* and *Gammarus zaddachi oceanica* were found at the north and north-western areas surveyed.

The most abundant medusa was *Periphylla*, found throughout the survey and reaching up to 300 cm. diameter. Siphonophores were found only in small numbers and were mostly *Dimophyes arctica* and *Nanomia cara*, but the warm water species *Chuniphyes multidentata* and *Nectopyramis thetis* were found at the south-west corner of the square and *Galettia biloba* at the western limit of the survey. Other relatively warm Atlantic species found were the radiolarian *Thalassicolla* which was distributed over the western edge of the square and the polychaete *Travsiopsis lanceolata* at 65°00'N., 28°25'W.

There thus appears to have been a penetration of the North Atlantic Drift into most of the area investigated, but especially between 27° and 29°W. and this was least evident in the extreme west and in the area between the Icelandic coast and 26°W.

During June a series of stations was worked in Faxa Bay which had a very different fauna

from that just described. Here decapod larvae were very common including especially *Munida*, *Eupagurus*, zoeas and *Nephrops* larvae. *Mallopus* larvae were abundant in the Bay but not elsewhere in the survey.

Between south-east Iceland and Faroe in June, over the ridge, the surface plankton was exceptionally poor though the deeper layers contained abundant *Calanus* and *Meganyctiphanes*. *Cyanea* was present at the surface. A line of samples was worked between Faroe and the Hebrides in June, and here also the surface plankton was extremely poor but the subsurface samples contained a rich mixture of oceanic species with Lusitanian species in the southern half of the section. This Lusitanian fauna (see report to the Near Northern Seas Committee) came from east of Rockall and became well mixed with the fauna of the North Atlantic Drift before passing on towards Shetland.

This area, between Faroe and the Hebrides, was also examined in July with an extension north-west of the Hebrides to beyond 15°W.; the outer part of these investigations were in the district now termed the Distant Northern Seas. Here, again, the surface collections were poor whilst the subsurface samples were comparatively rich, especially at and below 250 m. There is some evidence of Lusitanian penetration in the deep water between the North Atlantic Drift and the boreal water to the north-west of Lousy Bank. A new record of a fish for this part of the Atlantic is *Lampadena braueri* ZUGMAYER, and with it was another rare species *Lampanyctus iselini* PARR. Both were from 61°20'N., 14°22'W., on 19. July, in an oblique net from 1,200 metres. Phytoplankton was rich to the north-west of Faroe, where it was dominated by *Nitzschia seriata*, *Thalassiothrix longissima* and *Chaetoceros* spp.

No further plankton sampling was made in the Distant Northern Seas area until October when a series of stations was worked from Faroe towards Shetland. These showed the offshore collections to be rich in *Calanus* with an immense shoal of *Meganyctiphanes* at the surface and in the subsurface layers about halfway between Faroe and Shetland.

As these areas border on to those of the Near Northern Seas which have a more direct concern with Scottish conditions the significance of this work is discussed with the results in the nearer waters in the report to that Committee.

J. H. FRASER.

THE FISH

Plaice in Faxa Bay.

Figures 39 and 40 (see Tables 3 and 4) represent results of investigations carried out in Faxa Bay on board "María Júlía" from 1953 and 1954 and show the age distribution of the stock in percentages and the average length of the age-groups of plaice for these years. No sample was taken in February 1953 and otoliths were collected from only 60 specimens in November of that year.

As can be seen from Figure 39, the 1948 year-class is relatively strong, as it shows a predominance in the samples from both these years.

On the average length (see Figure 40) not much is forthcoming, except that the difference between the average length of the age-groups III, IV and V is due to exceptionally large numbers of small individuals belonging to

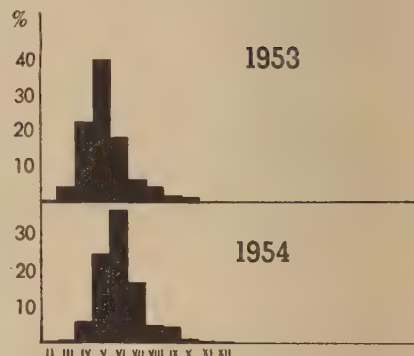


Figure 39. Age composition of plaice in Faxa Bay 1953 and 1954.

these age-groups in the samples from May 1953.

A. SIGURÐSSON.

Table 3. Plaice in Faxa Bay (May, August, November 1953).

Age-Groups	II	III	IV	V	VI	VII	VIII	IX	X	Total
No. of specimens.....	1	30	161	283	128	44	30	11	8	696
Average length.....	26.0	25.9	28.2	31.4	34.3	37.2	38.5	40.2	39.1	
Range.....	—	20—33	18—39	18—44	19—48	25—52	30—49	29—50	29—58	
%.....	0.1	4.3	23.1	40.7	18.4	6.3	4.3	1.6	1.1	99.9

Table 4. Plaice in Faxa Bay (February, May, September, November 1954).

Age-Groups	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
No. of specimens...	10	86	355	524	236	71	69	16	6	1	1374
Average length....	29.8	30.9	32.8	34.8	36.7	39.2	41.3	45.6	42.3	45	
Range.....	26—33	24—40	24—45	24—50	25—54	26—49	28—53	30—57	37—53	—	
%.....	0.7	6.3	25.8	38.1	17.2	5.2	5.0	1.2	0.4	0.1	100.0

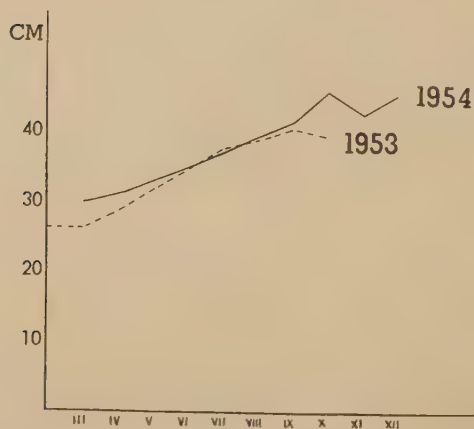


Figure 40. Diagram showing the average length of the different age-groups in Faxa Bay 1953 and 1954.

Redfish and Trade Ling from Faroe Waters.

In August 1954 German trawlers opened a new fishery in the N., NE., and E. of the Faroes in deep water of 300—400 m. depth. The landings from 26 trips from August till November totalled 3298 tons with an average of 10.7 tons per fishing day. The catch consisted mainly of redfish (62.5%) and ling (32.0%) with the following length composition:—

Redfish		Trade Ling		Trade Ling	
cm.	‰	cm.	‰	cm.	‰
25—29	1	60—64	2	95—99	158
30—34	—	65—69	5	100—104	105
35—39	14	70—74	19	105—109	64
40—44	340	75—79	40	110—114	38
45—49	586	80—84	90	115—119	24
50—54	54	85—89	237	120—124	17
55—60	5	90—94	200	125—129	1

ARNO MEYER.

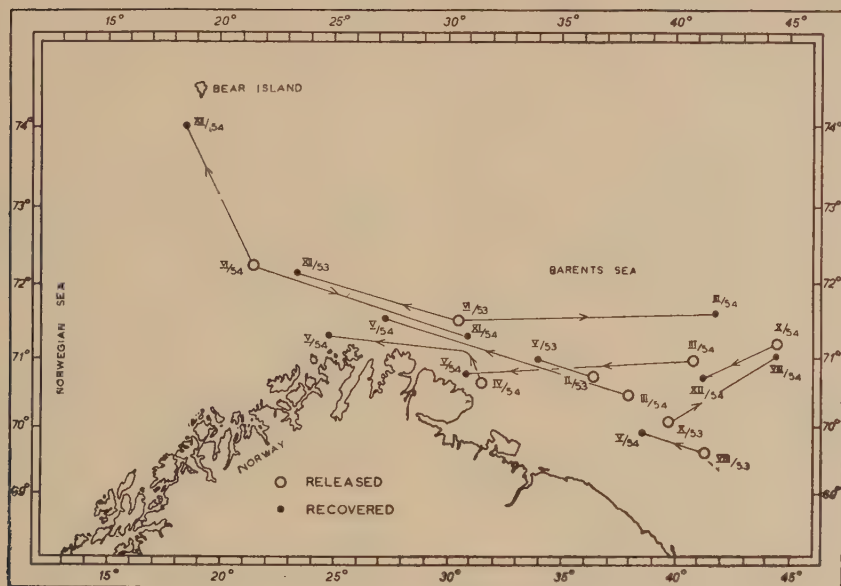


Figure 41. Recaptures of catfish migrated more than 50 naut. miles.

Catfish (*Anarrhichas minor*) tagged in the Barents Sea.

In connexion with an age and growth investigation tagging experiments on *Anarrhichas minor* began in 1953. Lea hydrostatic tags were attached with nylon through the back muscles in front of the dorsal fin.

During 1953 and 1954, 365 catfish were released at Spitsbergen, Bear Island, and in the Barents Sea. Of these 208 were caught with trawl and 156 with longline. At the end of 1954 21 had been recaptured from the trawl-caught group and 5 from the longline-caught group. The lower recoveries from fish caught with longlines may obviously be due to a higher mortality caused by the hook. The tagging experiments therefore in the next years will largely be based upon fish from trawl catches.

Of the 26 returns, 15 were recovered less than 50 naut. miles from the tagging locality, in 3 to 314 days after release. Four of these recoveries are from Bear Island and Spitsbergen, the others from the Barents Sea. The remaining fish had migrated more than 50 naut. miles. Figure 41 indicates that the catfish migrate from the eastern part of the Barents Sea to the banks off Finnmark during the spring and summer. They then travel back again in the autumn and winter. On the

basis of the fishing season on the coast of Finnmark it has been assumed that the catfish has a spawning migration in the spring and summer from the Barents Sea to banks off Finnmark where spawning occurs in June-July. The tagging experiments thus seem to support this conclusion.

O. J. ØSTVEDT.

Rare Fishes from Distant Northern Seas.

In 1954 the "Institut für Meeresforschung"-Bremerhaven (IFM), the "Abteilung Fischereibiologie der Biologischen Anstalt Helgoland"-Bremerhaven (BAH) and the "Institut für Seefischerei der Bundesforschungsanstalt für Fischerei"-Hamburg (IS) received the following rare fishes from the area named above. The verified record of 3 species, hitherto not known from that area, seems to be of some importance to a better knowledge of the geographical distribution of the NE. Atlantic ichthyofauna.

With regard to the taxonomy of *Aphanopus* it should be mentioned that *Aphanopus schmidtii* should eventually be treated either as a synonym of *A. carbo* or at least as a geographic subspecies of it. (TUCKER, 1954, in litt.). The following are responsible for the determination of the species: IFM: Dr. C. H. BRANDES, BAH: Dr. A. KOTTHAUS, IS: Dr. G. KREFFT.

1. *Alepocephalus bairdii* GOODE & BEAN 1879
29.5.54, 63°05'N.—12°45'W., 1♂, 82 cm. (IFM)
2. *Aphanopus schmidtii* SAEMUNDSSON 1907
22.6.54, "Rosengarten", 1♀, 107.5 cm. (IS)
3. *Brama brama* (BONNATERRE 1789)
10.8.54, Sido-Ground, 1 of 57 cm. (IFM)
15.8.54, Skafra-Deep, 1 of 54.5 cm. (IFM)
5.9.54, 63°07'N.—23°53'W., 1♀, 62 cm. (IFM)
4. *Centrolophus niger* (GMELIN 1788)
17.6.54, 63°37'N.—13°00'W., 1 of 48.5 cm. (IFM)
5. *Ceratias holboellii* KRØYER 1844
10.2.54, Westman Isl., 250 m. depth, 1♀, abt. 1 m. (IS)
18.6.54, 63°44'N.—12°W., 1♀, 67 cm. (IFM)
6. *Chauliodus sloanei sloanei* SCHNEIDER 1801
25.6.54, "Rosengarten", western part, 1 of 21.5 cm. (IFM)
11.7.54, "Rosengarten", western part, 1 of 16 cm. (IFM)
7. *Deania calceus* (LOWE 1839)
17.6.54, 63°37'N.—13°00'W., 1♀, 105 cm. (IFM)
8. *Diretmus argenteus* JOHNSON 1863¹⁾
29.6.54, "Rosengarten", 1 of 11.3 cm. (IS)
14.7.54, 62°54'N., 11°10'W., 540 m. depth, 1 of 8.1 cm. (IS)
9. *Hexanchus griseus* (BONNATERRE 1780)
18.3.54, 60°40'N., 2°30'W., 1 of abt. 250 cm. (IS)
10. *Himantolophus groenlandicus* REINHARDT 1837
18.6.54, "Rosengarten", 400 m. depth, 1♀ (IS)
11. *Lampadena braueri* ZUGMAYER 1914
1.9.54, 62°54'N., 11°10'W., 540 m. depth, 1 of 17 cm. (IS)
12. *Malacosteus niger* AYRES 1857²⁾
25.6.54, 63°20'—50'N., 11°—12°W., 1 of 17 cm. (IS)
13. *Nemichthys scolopaceus* RICHARDSON 1848
23.6.54, "Rosengarten", 1 of 99 cm. (BAH)
25.6.54, "Rosengarten", western part, 1 of 86 cm. (IFM)
14. *Notacanthus phasgonorus* GOODE 1881
10.4.54, Iceland, 1 of 102 cm. (IS)
25.5.54, "Rosengarten", 5 of 89.5—111.5 cm. (IFM)
11.6.54, —, 1 of 97 cm. (IS)
21.6.54, —, 1 of 98 cm. (IFM)
22.6.54, —, 1 of 116 cm. (IS)
15.7.54, 62°N., 10°40'W., 1 of 74.5 cm. (IS)
26.7.54, "Rosengarten", 3 of 92—95 cm. (IFM)
15. *Oxynotus paradoxus* FRADE 1929³⁾
27.4.54, 60°50'N., 10°30'W., 1♀, 83 cm. (IS)
16. *Paralepis coregonoides borealis* REINHARDT 1838
11.7.54, "Rosengarten", 2 of 27 and 28.5 cm. (IFM)
14.7.54, 62°20'N., 12°10'W., 460 m. depth, 1 of 28.8 cm. (IS)
17. *Polyprion americanus* (BLOCH 1801)
22.3.54, Svinöy, 1 of 59 cm. (BAH)
18. *Trachypterus arcticus* (BRÜNNICH 1788)
1.3.54, 60°N., abt. 3°E., 1♀, 142 cm. (IFM)
13.7.54, "Rosengarten", 1♂, 145 cm. (IS)
11.9.54, 63°15'N., 22°55'W., 1 of 158 cm. (IFM)
27.9.54, 62°55'N., 9°10'W., 1 of 140 cm. (IFM)
19. *Trachyrhynchus murrayi* GÜNTHER 1887
8.6.54, 63°45'N., 12°30'W., 530 m. depth, 1 of 35.3 cm. (IS)
20. *Rhinochimaera atlantica* HOLT & BYRNE 1910
10.6.54, "Rosengarten", 1♀, 136 cm. (BAH)
21. *Xenodermichthys copei* (GILL 1884)
17.6.54, 63°37'N., 13°00'W., 2 of 16.7 and 17 cm. (IFM)
25.6.54, "Rosengarten", western part, 1 of 16 cm. (IFM)

²⁾ First record, the northernmost find up till now was abt. 42°N. The specimen is also in the possession of the "Institut für Küsten- und Binnenfischerei", collected by Dr. H. KÜHL and determined by Dr. G. KREFFT.

³⁾ First record, the northernmost find up till now was off western Scotland in 58°30'N.

¹⁾ First record, hitherto in the North Atlantic only known as far north as off SW. Ireland. The first specimen is in the possession of the "Institut f. Küsten- und Binnenfischerei", Cuxhaven, collected by Dr. H. KÜHL and determined by Dr. G. KREFFT.

C. H. BRANDES,
A. KOTTHAUS,
G. KREFFT.

Near Northern Seas.

INTRODUCTION

Through the change in the committee system of ICES, which was adopted in 1954, a situation has arisen which is not completely satisfactory. Of the more important fish species there are now only the flatfish to be dealt with within the present area committee. As a result the report is mainly of a hydrographical nature though with some biological contributions. Gadoid fish, herring and many other important fishes are dealt with in the reports from the different committees on scientific subjects. This system does not allow of a general review of the total mixed fish stock in the North Sea. In addition it is not possible to compare directly reports from previous years with similar ones from the current year as the limits for the areas have been changed. However, to judge by the different reports the research work in the Near Northern Seas has continued in a satisfactory way even if much remains to be done before we are able to completely manage the living resources of the North Sea.

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AA. J. C. JENSEN
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N. JERLOV

A. Environment.

The continued Scottish work concerning Near Northern Seas and Approaches has given us a clearer picture of the Atlantic influence

on the northern North Sea water. The situation in the Orkney-Scotland Channel, however, is rather complex and requires more study. Of special interest are the recoveries in Skagerrak of drift-bottles liberated from the more southerly of the Weather Ships. However, it is impossible to know if these bottles have drifted north of Scotland or through the Channel. It is also of interest to note that the area between Scotland—Outer Hebrides and the Irish coast seems to be of a lesser oceanic character than the north-western North Sea. This condition depends on the influence from the Irish west coast, Irish Sea water and the heavy rainfall on the west coast of Scotland.

The continued chemical investigations of the surface distribution of phosphate and oxygen makes it possible to compare the present observations with those for the two previous years during which such observations were carried out. In accordance with what was known from other observations the chemical ones also indicated that the conditions in the northern North Sea during the autumn of 1953 were of Atlantic character. The summer of 1954 shows very small differences in the scale of phosphate values compared with 1952. The area with the minimum phosphate value, however, has changed its position from the central North Sea in 1952 to the eastern part in 1954. The low oxygen values in the areas most influenced by the Atlantic are also noteworthy.

On the "Bløden Ground" there is close resemblance between the summers of 1953 and 1954. The September observations which were interrupted by a strong gale are of interest as they show the mixing influence of a strong wind.

The temperature off the eastern coast of Scotland shows an average anomaly for 1954 of $0.5^{\circ}\text{C}.$ as against $1.0^{\circ}\text{C}.$ in 1953.

From the German Bight there are now available daily observations of temperature and salinity from 1949 and some from 1948. All these observations will be published but the monthly means are presented here in the German reports. The long-time variations in the German Bight can now be followed

through the monthly and annual means of surface temperature for the period 1872—1950 and surface salinity for the period 1873—1950, both series from the Helgoland Roads.

The surface temperatures from the observations in the German Bight in 1954 and also from the Danish lightvessel "Vyl" are very low especially during the spring. The salinity values from "Vyl" in 1954 show great differences from those of 1953 and the differences are all positive both from the surface and the bottom.

In Kattegat and at the Norwegian Skagerak coast the surface temperature was above normal in January but lower than normal in February and March.

The plankton evidence from the Scottish research work shows great resemblances in the distribution of the oceanic species in 1953 and 1954, which is in conformity with the hydrographical data. At the same time though the autumn influx of plankton in the North Sea reached about as far as in 1953 it was, however, of a more mixed origin and evidently combined with a weaker water movement.

The Continuous Plankton Records indicate that 1954 within the surveyed area was an extremely poor year for copepods, the poorest of the six years during which these observations have continued. An exception was, however, the area off Moray Firth, which area during July and part of August also showed a very strong increase in pteropods. This increase might, however, have originated from an indigenous population.

"Indicator species" in the plankton have changed in their distribution during the comparatively few years of observation so that they now occur up to two months earlier. This is especially clear in route W but it is also noticeable off the north-eastern coast of Scotland. Whether the pteropods *Limacina* and *Clione* which in the northern North Sea vary and occur in the same manner as salps and doliolids are local populations or of Atlantic origin requires further studies.

The German investigations on the bottom fauna indicated that the stock of first-class plaice food, Lamellibranchiates, was the poorest since 1949 when the investigations started. In autumn of 1954, however, the Polychaetes reached their first maximum since 1949.

B. Fish.

Eggs and Larvae. In Kattegat the plaice larvae were totally absent during the investigations in May and June; larvae of flounder, however, were present in large quantities.

Plaice. The rich 1947 year-class seems now to have vanished from the German Bight and the Danish North Sea coast. In the German Bight the following year-classes seem to be poor until the 1952 year-class which is rather good. The 1953 year-class is good, perhaps of the same strength as the 1947 year-class and the two year-classes 1952 and 1953 will be very important in the commercial fishery during the next few years. The strength of the two youngest year-classes corresponds with a very good spawning in the area NW. of Helgoland in 1952 and 1953. Off the Jutland coast, however, the 1950 year-class seems to be good, but the stock of small plaice at "Bløden Ground" seems to have been recruited from the south or south-west as the good Danish 1950 year-class has not had any influence on this stock.

In the Kattegat coastal area the 1954 0-group was much poorer than normal as was also the case with the 1953 0-group. The comparatively great number of II-group plaice in the central and southern Kattegat in 1954 must, according to the Danish investigations, depend on an immigration from the northern Kattegat.

The Danish transplantation of plaice to the Limfjord has continued and in that connexion new marking (tattooing) and tagging methods have been tried. The recapture by weight was about 55%.

Dab. The growth rate of the dab in the German Bight is indicated to be very slow.

Eel. The yield of the silver-eel fishery in the Limfjord was predicted to be ca. 5% below the normal but actual comparisons could not be made on account of changes in the collection of Danish fishery statistics.

Fish for industrial purposes. The Danish catch of fish for fish-meal factories, etc. from the present area increased by 22% as compared with 1953 to 187 mill. kg. Of this catch about 60% was herring and mostly small herring. After the enforcement of the London Convention of 1946 the catch of undersized whiting markedly decreased.

J. HULT.

ENVIRONMENT

Hydrography.

Near Northern Seas and Approaches.

General.

The scope of Scottish hydrographic work during 1954 is given in Table 1, representing operations mainly in the northern North Sea in all months from March to October inclusive, in the Faroe-Shetland Channel and west Scottish coastal waters in February, March and April, June, July, October and November, in Iceland-Greenland waters in May-June, and in the nearer north-eastern Atlantic Ocean between latitudes 52°N. and 61°N. and westward to longitude 18°W., in July and August.

The apparently reduced effort in 1954, as compared with 1953, in respect of the number of hydrographic stations occupied and the consequent numbers of temperature and salinity observations taken — although certain other data show more or less substantial increases over those of the previous year — is to be explained by the effect of severe weather conditions on ships' operations during a great part of the year.

Following the evidence towards the end of 1953 of increased oceanic influence in the Faroe-Shetland Channel and the northern North Sea, as estimated by temperature and salinity distributions, this evidence was considerably enhanced by the earliest observations north of Scotland in 1954 and by the trend of drift-bottle recoveries from Weather Ships' liberations in the last quarter of 1953, as well as in the beginning of 1954. This influence apparently suffered more or less considerable retraction in March 1954, probably extending into April. By the following month, however, the oceanic force had in-

creased in strength, particularly within the area of its influence in the northern North Sea, but from July to September inclusive the second retraction for the year was very considerable. Again, it is apparent that towards the end of the year the oceanic incursion to the northern North Sea through the Faroe-Shetland Channel was once more waxing in strength, although through lack of sufficient observations in December due to very stormy weather the evidence is somewhat inconclusive.

The total drift-bottle return from the year's liberations at 14½% is low, but this ratio is considerably influenced by those pertaining to north-eastern Atlantic and Faroe-Shetland Channel liberations, including those at the Weather Stations "I" and "J". As can be seen from Table 2, returns from these oceanic liberations are of the order of only 9–13%, while from North Sea liberations the percentage recovery is no less than 22%, a proportion which compares favourably with those of pre-war years when the bulk of drift-bottle liberations were carried out within the North Sea.

For the first time since the year 1951 French coast recoveries are recorded among the records from liberations at or *en route* to Weather Station "J". Actually, one of the five records tabulated was a Dutch coast recovery, the drifter having obviously passed eastward through the entire length of the English Channel. This recovery took place in November 1954, the remaining four on the north-west coast of France in August and September. As is normally to be expected, the bulk of recoveries from this Weather Station took place on the west Irish coast, and some half-dozen

Table 1. Scottish Hydrographic Operations, 1954.

Vessel	Hydro- graphic Stations	Temp. Observa- tions	Salinity Observa- tions	Oxygen Observa- tions	Phosphate		Drift-Bottles		Drift-Envelopes	
					Free	Total	Liber- ations	Recov- eries	Liber- ations	Recov- eries
"Scotia".....	564	3251	3259	1188	1594	102	760	239	230	52
"Explorer".....	288	2177	1624	696	1145	—	450		295	
"Clupea".....	421	1373	1061	—	657	—	15		—	
"Kathleen".....	32	50	50	6	6	—	80	—	75	—
"Silver Scout".....	169	508	342	—	169	—	—	—	—	—
North Carr Lightship.....	75	75	75	—	—	—	—	—	—	—
Weather Ships.....	—	—	—	—	—	—	1230	130	—	—
Totals.....	1549	7434	6411	1890	3571	102	2535	369	600	52

Table 2. Drift-Bottles at Weather Stations "J" (A) and "I" (B), in the Faroe-Shetland Channel and NE. Atlantic Ocean (C), and in the North Sea (D), 1954.

	Liberations No. of	Recoveries																	Totals			
		Frequency-Distribution ¹⁾																				
		Drifters	0'	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14		15	16	17
A	545	—	5	38	18	—	—	—	—	—	—	—	—	—	3	—	1	—	—	—	—	65
B	685	—	—	3	28	13	8	1	—	—	—	—	—	—	—	1	7	—	—	2	2	65
C	555	—	—	11	7	20	9	—	—	—	—	—	—	—	11	4	10	1	—	1	—	74 ¹
D	750	—	—	—	—	14	13	—	1	—	—	—	—	—	46	39	50	1	1	—	—	165

¹⁾ For definition of the column numbers in this table see footnote p. 94 of Ann. Biol., 8 (1951).

on the south-west English coast through the Bristol Channel. As coming from liberation positions situated more or less considerably to the northward of their respective stranding-places, the three Irish returns tabulated against the Weather Station "I" are noteworthy. Similar results have previously been recorded and clearly signify, in respect of surface waters at least, that over a broad band of deep waters between about Rockall and the British Isles, the dominant current is by no means always northward.

It is of interest also to note that no less than three drifters from the more southerly Weather Station ultimately reached the Skagerak and therefore must have coursed within the North Sea. The question, however, cannot for the time being be answered as to whether these particular drifters, all of which registered long drift-periods, entered the North Sea through the English Channel or by way of the north of Scotland.

Skagerak recoveries from all liberations, including no fewer than eleven from the Faroe-Shetland Channel region, took place chiefly in the months of October and November 1954, as also did Norwegian North Sea coast strandings.

Norwegian coast recoveries outwith the North Sea, which usually give good broad indications of the waxing and waning strengths of the Atlantic Current through the Faroe-Shetland Channel, bear out rather remarkably the foregoing interpretations of temperature and salinity distributions. The month of May 1954, for instance, shows up strongly in comparison with the previous and following two months as regards this category of drift-bottle returns and again, from September onwards, after a decline to unity in the month of July, these returns increased in numbers to a high climax in January 1955.

Drift-envelope returns, under 10% of the number of liberations, do not in the majority

compare well with contemporary drift-bottle records. A new type of plastic envelope drifter will be tested in 1955.

The data on the chemistry of the sea are reported elsewhere.

J. B. TAIT.

Hydrographic Conditions in the Minch and the Northern Approach to the Irish Sea.

Observations were made in this area during the autumn of 1954 in association with herring larvae surveys. Temperature and salinity observations were made at surface and bottom at 158 stations and the results are presented in charts (Figures 1 and 2). The salinity values have been plotted in the form of D.C.I. (Defined Coastal Influence) which is fully explained in Vol. 10 (North Sea) of this journal. The results taken along with previous surveys, Vol. 10 and Vol. 8 (North-Western Area) give an indication of typical autumn conditions in this region.

1. Perhaps the first point which ought to be emphasized is that the region extending from Cape Wrath—Butt of Lewis in the north to the Irish coast and bounded on the west by the Outer Hebrides is, on the whole, distinctly less oceanic in character than the north-western North Sea, for example. The proximity of this region to the vast Atlantic might have suggested otherwise. Factors contributing to this situation appear to be the considerable influence of Irish west coast and Irish Sea water, and the heavy rainfall on the west coast of Scotland generally.

2. Such oceanic influence as exists takes the form of a powerful thrust into the South Minch, with a lesser branch directed towards the mouth of Loch Linnhe. These thrusts, though dominating the hydrography of the region, are composed of oceanic water which has suffered appreciable dilution. In this connexion D.C.I. values of 0.3 or less would be described as truly oceanic.



Figure 1. Salinity in the Minch and northern approaches to the Irish Sea, expressed as D.C.I. (Defined Coastal Influence).
Main survey 30. September—19. October 1954. Supplementary survey 23.—25. November 1954.
(a) Surface D.C.I. (b) Bottom D.C.I.

3. Heavy dilution occurs in all the mainland estuaries and inlets. In these and in the South Minch, surface D.C.I.s are considerably higher than those at the bottom. Elsewhere, the vertical gradients are practically nil.

4. The temperatures are nearly the same at surface and bottom everywhere except in the

South Minch, where the underlying water is considerably colder than any other water in the region. The warmest water is in the Irish Sea; the Firth of Clyde is significantly cooler, as is also the north-eastern Minch.

5. The charts suggest a northerly flow out of the Irish Sea and northerly flow of deep



Figure 2. Temperatures in the Minch and northern approaches to the Irish Sea. Main survey 30. September—19. October 1954.
Supplementary survey 23.—25. November 1954.
(a) Surface Temperature. (b) Bottom Temperature.

water through the Minch, while the surface waters in the latter region appear to have a less clearly defined movement.

6. As compared with the autumn of 1953 (a) the D.C.I. of the oceanic thrust has increased by about 0.2 (quite a significant

difference) and (b) temperatures in 1954 are at least 1° higher than in the previous year. We note also (c) that by contrast with 1953 there is no indication of drift into the Irish Sea round the north of Ireland.

R. E. CRAIG.



Figure 3. Surface temperatures of the northern North Sea 1954.

(a) 14. March—1. April.

(b) 12. April—4. May.

(c) 13. June—7. July.

(d) 2.—16. August.

Hydrographic Surveys of the Northern North Sea.

A large number of detailed surveys have been carried out by the research vessel "Clupea" from 1951—1954 during the months

April-September. These surveys have been made as part of the herring investigations of the Scottish Home Department, and cover an area approximately 60 miles square extending north and east from Aberdeen. It is hoped



Figure 4. Bottom temperatures of the northern North Sea 1954. For dates of survey see Figure 3.

within a reasonable space of time to publish some account of this work.

In 1954 it was possible to arrange for these surveys to coincide approximately in time with more extensive surveys by other research vessels, and four surveys were obtained giving a comprehensive picture of conditions in the

northern North Sea. The value and general interest of the data have thus been enhanced to a point where it is considered useful to publish them in this journal. In Figures 3-6 will be found temperature at surface, temperature at bottom, D.C.I. at surface and D.C.I. at bottom. The term D.C.I. (Defined Coastal



Figure 5. Surface D.C.I. of the northern North Sea 1954. For dates of survey see Figure 3.

Influence) is fully explained in this journal Vol. 10, North Sea.

The charts of surface temperature and salinity values overlap the routine I.C.E.S. charts of surface conditions which are published on a monthly basis. Presentation of the bottom data requires no apology as it is thought

that no such comprehensive information has been available before.

We may summarize some of the features of the 1954 data as follows:—

(a) Comparable data from previous years are less extensive but 1954 conditions generally seem not to be atypical. Temperatures off the

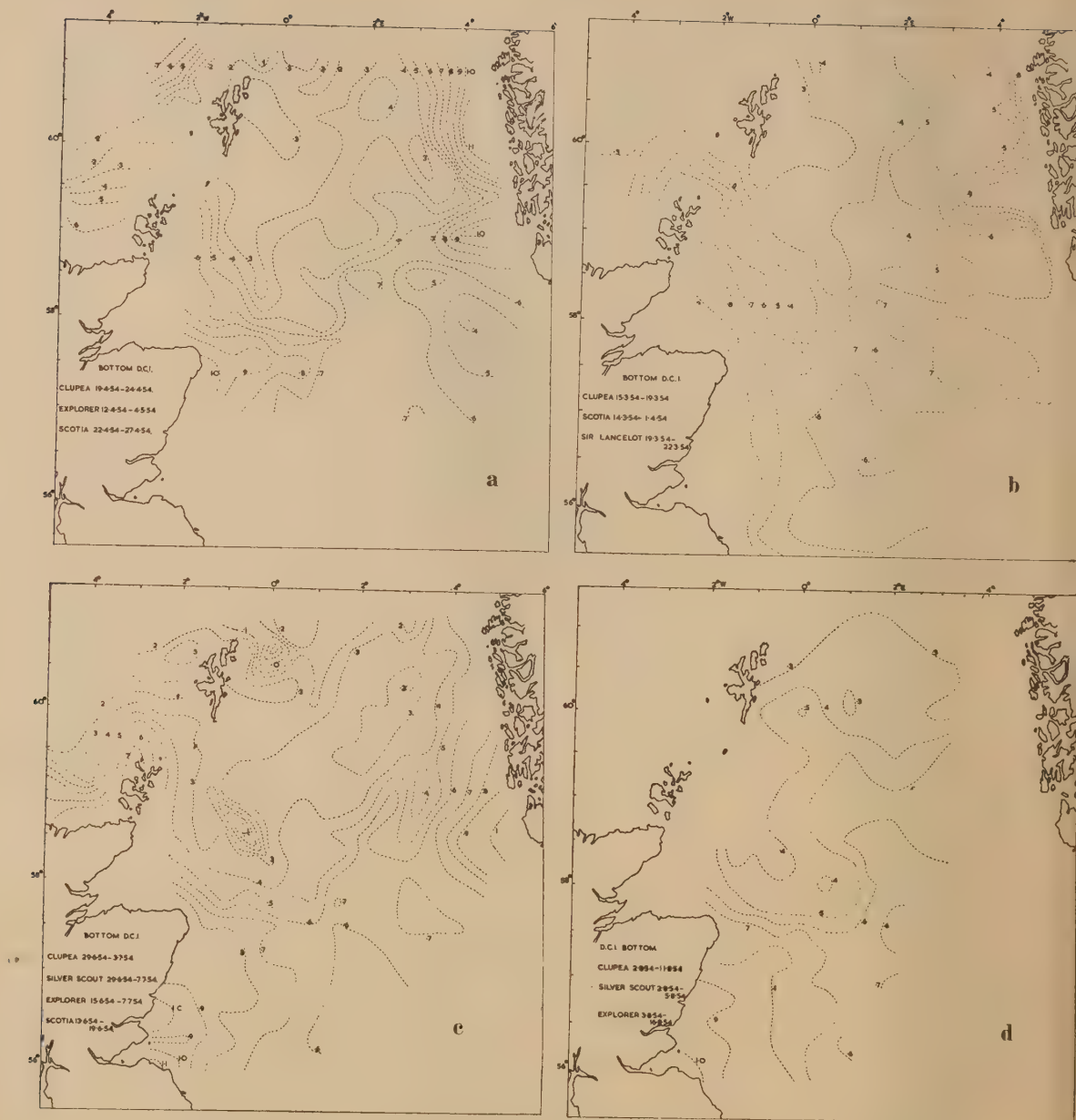


Figure 6. Bottom D.C.I. of the northern North Sea 1954. For dates of survey see Figure 3.

Scottish east coast in May-June were about 1° colder than in 1953 and would thus appear to approximate to the long-term mean which has been estimated by SMED (Ann. Biol., 10, North Sea).

(b) It appears that invasion of the North Sea by warm water in the spring took place

both to the west at about the prime meridian and also between 2° — 3° east. The western stream appears to dominate in the March survey and the eastern in the April survey.

(c) It appears that in the March survey there was influx of oceanic as well as coastal water through the Orkney-Shetland Channel, which

was no longer apparent in April. The situation is complex and there is need for further investigation of the Orkney-Shetland Channel.

(d) It is interesting to observe how the characteristic temperature distribution in March develops to give two striking patches of relatively warm water in April. The warm patch which is most distinctive lies about 50 miles east of Duncansby Head, and has been noted in previous years (CRAIG, Ann. Biol., 9, North Sea).

(e) The confinement of eastern coastal waters east of longitude 3° east in the early part of the year and its gradual spread practically to the prime meridian by August is clearly shown, this being a characteristic feature whose year to year variations in extent have been studied for a long time.

The March survey includes data from a cruise of the English research vessel "Sir Lancelot" whose co-operation is hereby acknowledged.

R. E. CRAIG.

Chemical Observations.

Figures 7—10, for winter 1953—54 and July-August 1954, give the surface distributions of free phosphate (as $\mu\text{g.}$ -atoms phosphate-phosphorus per litre) and dissolved oxygen (as cc. O_2 per litre) which can be compared with those of the previous years (JOHNSTON, 1953 and 1954). Collateral information on temperature and salinity distribution is readily

available in the appropriate monthly *Synoptic Hydrographic Charts* and Notes.

Winter 1953—54.

Surveys in November 1953 and March/April 1954, gave a particularly good winter picture of surface phosphate concentrations. Although these surveys were separated by some four months in the time of sampling, which included 75 stations worked on both occasions, the mean variation between the samples on the two surveys was only $\pm 0.050 \mu\text{g.}$ -at. PO_4/P per litre except in Norwegian coastal waters (as defined by oxygen values > 6.6 cc. O_2 per litre), where the variation was ± 0.085 units. The oxygen picture, however, is based on the rather scanty material of the March/April survey.

It has already been pointed out by TAIT (1954) that there was an oceanic influx into the North Sea of considerable intensity at least during the autumn and early winter of 1953, extending as far south as latitude $55^{\circ}40' \text{N.}$ in the western part of the North Sea. This influx brought an accompanying fauna containing some Lusitanian species assessed by FRASER (1954) as extending at least as far south as 57°N. and persisting in patches until December. The conditions were therefore not unlike those of 1952—53. Perhaps as a result of the admixture during two successive years of considerable amounts of this water, which is rather poor in nutrients, there was an overall decrease of the order of $0.1 \mu\text{g.}$ -at. PO_4/P per litre in the



Figure 7. Free phosphate. Winter 1953—54.
 $\mu\text{g.}$ -at. phosphate-phosphorus per litre. Surface.



Figure 8. Dissolved oxygen. Winter 1953—54.
Cubic centimetres oxygen per litre. Surface.

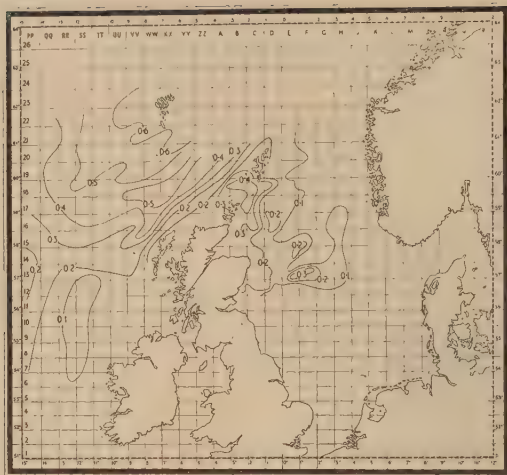


Figure 9. Free phosphate. July-August 1954.
µg.-at. phosphate-phosphorus per litre. Surface.



Figure 10. Dissolved oxygen. July-August 1954.
Cubic centimetres oxygen per litre. Surface.

free phosphate concentration in the North Sea. Oxygen values, changing in sympathy, were decidedly low compared with 1952–53 within the track of the oceanic influx.

As stated by RAE (1954), "the conditions within the northern part of the North Sea during the autumn of 1953 were more similar to those prevailing in the Atlantic" and the present results indicate that chemical conditions were in agreement.

July–August 1954.

The data used were from two "Scotia" cruises, viz. Faroe-Hebrides region in July and Rockall-West Ireland region in August, and from the "Explorer" North Sea survey in August. Concentrations of dissolved oxygen of <6.0 cc. O₂ per litre (Figure 10) occurred in the surface waters of that part of the north-west Atlantic examined to the south of about 58°N., and in the North Sea except along its western edge. The same areas may also be delineated by the criterion of <0.3 units of phosphate (Figure 9). Within these areas the chlorophyll-containing section of the phytoplankton was very poor, although even there it was relatively 5 to 10 times greater in the North Sea than in the Atlantic. In the Atlantic part the water was very clear and contained mostly jelly-like organisms such as salps, while the North Sea part showed a residual crustacean plankton which, however, decreased greatly in quantity east of 1°E.

The remaining area, which has oxygen values mostly above 6.2 cc. O₂ per litre, is

rather complex. At the extreme north-west station, just beyond the limits of the diagram at QQ21, the surface water, as assessed from its plankton content, was of mixed north Atlantic and boreal water and it had an oxygen content of 6.30, phosphate 0.37. A large triangular area based on Faroe and extending to Lousy Bank had high oxygen (6.30–6.75) and phosphate (0.50–0.67) contents and was associated with good to rich diatom growth, principally *Nitzschia seriata*, *Thalassiothrix longissima* and chaetocerids. The results from net hauls are fully substantiated by chlorophyll estimates. The extensions immediately north of Lousy Bank and into and through the Faroe Channel, of surface oxygen values 6.0–6.3 and phosphate values 0.3–0.5 are taken to represent the direction of the most oceanic component of the North Atlantic Drift. The area delineated thus also had markedly lower chlorophyll concentrations and phytoplankton net yields (i.e., nil or very poor) than on either side of the Channel. Along the edge of the continental shelf on the south side of the Faroe Channel, plankton production was still active, although declining. In a limited region of high oxygen content *Thalassiothrix longissima* and mixed *Ceratium* spp. occurred; near Shetland *Rhizosolenia* spp. (in active growth, metamorphosing, and dead) were common along with dinoflagellates, chiefly *Ceratium tripos*.

It is difficult to compare the chemical conditions this year (July/August) with last (June)

since at this season oxygen and phosphate values are changing rapidly. It may at least be stated that the July/August picture in 1954 was fairly consistent with the type of distribution found in June 1953, if one makes allowance for higher oxygen values and smaller depletions of phosphate to be expected in the earlier part of the year. It is again apparent that phosphate uptake took place first in the eastern and central parts of the area of the North Sea surveyed and in regions off the west coasts of Ireland and the Hebrides.

There is little difference in the scale of phosphate values encountered in the same months of 1954 and 1952. The area of minimum phosphate which occurred in the central part of the North Sea in 1952, however, was found in the eastern part in 1954. Also, surface oxygen values in the central region were lower in 1954. Perhaps the most striking feature of the comparison of Figure 10, 1954 and Figure 6, 1952, are the lower oxygen values in the regions of main oceanic influence.

For July/August 1954, the general impression from surface records of temperature, salinity, oxygen, phosphate and plankton is one of a slow North Atlantic Drift at the surface, forming only a dilute and slow-moving penetration along the western edge of the North Sea.

A notable feature in the surface salinity values is the progressive disappearance of water of $> 35.2\text{‰}$ from the northern North Sea between June and September 1954; in the corresponding period of 1953, salinities $> 35.3\text{‰}$ were never absent.

R. JOHNSTON.

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Monthly Anomalies of the Surface Temperature in an Area off the Eastern Coast of Scotland in 1954.

Table 3 gives for each month of 1954 the temperature anomaly in the area F (56° — 60° N., 0° — 3° W., see Figure 11), the grand

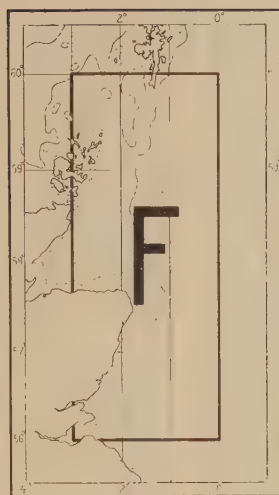


Figure 11. Location of area.

monthly means for 1° -squares over the period 1876—1915 being used as standard.

Table 3. Monthly Anomalies (Δ° C.) and Numbers (n) of Observations of the Surface Temperature in the Area F (see Figure 11) in 1954.

Jan.	Feb.	March	April	May	June	July
Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n
1.5 37	0.5 28	0.2 36	0.9 44	0.8 41	0.7 61	0.1 47
Aug.	Sept.	Oct.	Nov.	Dec.	Average of Δ -values	
Δ n	Δ n	Δ n	Δ n	Δ n		
0.5 55	0.0 60	0.1 57	0.0 35	0.4 50	0.5	

It appears from Table 3 that none of the monthly anomalies are negative. The high anomaly for January is a continuation of the high anomalies for the last quarter of 1953. For the following months there is a decrease of the anomalies, and for the last half of 1954 they are only small, in fact about 1° C. less than for the last half of 1953. Averaged over the year the anomaly is 0.5° C. as against 1.0° C. in 1953.

JENS SMED.

German Bight.

Daily surface observations (8h MET) of temperature and salinity have been carried out by German lightships since 1949, but some were made in 1948. The individual values will be published in the form of a yearbook under the title of "Meereskundliche Beobachtungen und Ergebniss". In addition to this, monthly means are given here, viz. for all observation

Table 4. Monthly Means of Salinity and Temperature in the Years 1948-1954 at Surface and Bottom for the German Lightvessels "S 2", "Borkumriff", "P 8", "P 12", "Elbe 1" and "Weser".

(From Deutsches Hydrographisches Institut, Hamburg).

	Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity "S 2"		Surface											
	1948	—	—	—	—	—	—	—	—	—	—	—	—
	1949	—	—	—	—	34.61	34.57	34.57	34.60	34.68	34.84	34.83	34.64
	1950	34.52	34.47	34.55	34.63	34.74	34.66	34.68	34.79	34.80	34.73	34.70	34.68
	1951	34.70	34.66	34.69	34.80	34.70	34.60	34.58	34.61	34.61	34.49	(34.54)	34.59
	1952	34.69	34.79	34.73	34.57	34.46	(34.52)	—	34.68	34.74	34.82	34.62	34.62
	1953	34.60	—	34.83	34.79	34.64	34.65	34.61	34.71	34.75	34.78	(34.67)	—
"S 2"		Bottom											
	1948	—	—	—	—	—	—	—	—	—	—	—	—
	1949	—	—	—	—	34.62	34.57	34.59	34.55	34.65	34.78	34.77	34.64
	1950	34.50	34.55	34.51	—	34.81	34.71	34.74	34.80	34.75	34.69	34.67	34.65
	1951	34.66	34.65	34.68	34.78	34.71	34.72	34.67	34.71	34.69	34.62	34.58	34.54
	1952	34.62	34.75	34.70	34.61	34.59	34.65	—	34.65	34.68	34.67	34.52	34.55
	1953	34.55	—	34.77	34.73	34.57	34.60	34.62	34.66	34.72	34.75	34.70	—
"Borkumriff"		Surface											
	1954	—	—	(32.59)	33.24	32.92	33.30	33.42	32.76	33.48	33.41	33.42	33.45
"Borkumriff"		Bottom											
	1954	—	—	32.83	33.22	32.88	33.56	33.37	33.09	33.53	34.12	33.45	32.55
"P 8"		Surface											
	1948	—	—	—	—	—	—	—	—	—	—	—	—
	1949	—	—	—	—	—	—	—	32.80	33.75	33.99	34.42	34.02
	1950	34.77	34.26	34.26	33.96	33.21	33.20	34.03	33.86	33.60	34.23	34.55	33.68
	1951	33.82	33.68	33.44	33.28	33.19	32.73	33.41	33.40	33.08	33.42	33.56	33.41
	1952	33.55	33.85	34.08	33.90	32.72	32.74	32.55	32.71	32.71	33.41	33.71	33.70
	1953	32.75	32.99	31.60	33.28	32.55	32.57	32.99	32.60	32.24	32.90	33.81	34.06
"P 12"		Surface											
	1948	—	—	—	—	—	—	—	—	—	—	—	—
	1949	—	—	—	(33.16)	(30.73)	30.39	29.96	(31.74)	(33.04)	33.23	33.52	33.09
	1950	33.52	34.11	32.53	32.24	32.08	31.63	32.81	33.16	33.24	32.67	33.64	32.84
	1951	33.16	33.18	32.89	31.73	32.03	32.29	31.91	32.75	32.76	33.29	33.34	32.36
	1952	32.23	31.02	32.71	33.13	32.10	31.18	30.68	31.65	30.97	31.44	32.66	32.59
	1953	32.13	30.77	30.06	32.10	31.23	32.10	32.50	31.09	30.91	31.67	32.83	33.47
"Elbe 1"		Surface											
	1948	—	—	—	—	—	—	—	—	—	—	—	—
	1949	—	—	—	—	—	—	(30.62)	30.93	31.77	32.54	33.36	32.50
	1950	32.42	32.43	30.60	31.40	31.40	31.69	32.54	32.49	32.73	32.24	32.72	31.95
	1951	32.04	32.01	31.56	30.62	31.19	32.26	31.24	32.30	32.26	32.27	33.02	31.95
	1952	31.34	30.31	31.45	31.88	31.51	30.71	30.34	31.00	30.49	30.92	31.63	31.65
	1953	31.36	29.37	28.07	30.93	31.04	31.63	32.11	32.41	30.42	30.53	32.48	32.69
"Weser"		Surface											
	1948	—	—	—	—	—	—	—	—	—	—	—	—
	1949	—	—	—	—	—	(30.80)	30.93	31.54	32.52	33.11	33.54	32.68
	1950	33.06	33.22	32.56	32.51	32.60	32.51	33.04	33.17	32.63	32.56	33.14	32.05
	1951	32.02	32.30	31.63	31.20	32.58	32.94	32.51	32.68	32.56	32.93	33.02	31.93
	1952	31.01	31.44	32.21	32.84	32.25	31.46	31.51	31.63	31.42	31.63	31.94	32.21
	1953	31.34	30.15	31.22	31.74	32.22	32.36	32.23	31.35	30.82	31.54	32.32	33.06
	1954	32.25	32.89	33.06	32.09	32.62	32.78	32.86	32.54	31.76	31.94	31.94	33.04

series available since 1948. The lightship "S 2" (54°00.5'N., 3°32'E.) has been definitely withdrawn from position as from 9. November 1953. As a substitute the lightship "Borkumriff" has been established since 17. March, 1954 on 53°44.9'N., 6°24.2'E. From lightships "P 8" (54°16'N., 7°11.5'E.), "P 12" (54°00'N., 7°51'E.), "Elbe 1" (54°00'N., 8°10.7'E.) and

"Weser" (53°51.6'N., 7°53.1'E.) homogeneous observation series are available being representative of the estuaries and coastal waters of the German Bight. The monthly mean values are shown in brackets if based on less than 15 daily separate observations. Only from lightships "S2" and "Borkumriff" were hydrographical observations carried out at

Table 4 (continued).

	Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Temperature													
"S 2"							Surface						
	1948	—	6.2	5.5	7.0	10.0	12.5	(15.1)	15.6	(15.1)	13.7	11.3	9.3
	1949	(7.1)	6.6	—	—	9.0	11.8	14.3	15.5	16.9	15.2	11.6	8.5
	1950	7.0	5.8	5.6	6.7	9.2	13.3	15.1	16.6	15.3	13.2	10.9	7.5
	1951	6.4	5.6	5.3	6.3	8.2	12.4	14.4	15.2	15.1	14.4	11.9	9.2
	1952	6.6	5.3	5.5	6.5	10.4	12.1	—	15.9	14.7	12.3	9.6	7.0
"S 2"	1953	5.7	—	5.2	6.3	8.9	12.6	15.4	16.3	15.5	14.4	13.2	—
							Bottom						
	1948	—	—	—	—	—	—	—	—	—	—	—	—
	1949	—	—	—	—	8.0	8.9	11.5	12.5	14.4	14.4	12.0	8.2
	1950	6.7	5.5	5.2	—	7.7	8.7	10.7	12.7	14.9	13.0	10.7	7.6
	1951	6.5	5.3	4.9	5.7	7.1	8.4	10.3	12.7	14.8	14.3	12.1	8.9
"Borkumriff"	1952	6.5	5.0	5.1	5.0	6.7	7.9	—	14.1	14.8	12.9	9.5	7.3
	1953	5.7	—	5.4	5.9	7.7	10.0	11.8	15.5	15.6	14.5	13.2	—
							Surface						
	1954	—	—	2.2	5.3	8.8	13.3	15.2	16.2	16.0	13.3	10.3	7.8
							Bottom						
	1954	—	—	2.0	5.7	9.2	13.8	—	16.3	16.4	13.5	11.0	7.9
"P 8"							Surface						
	1948	(7.1)	4.3	(4.0)	(6.5)	(9.9)	12.8	15.1	17.2	15.4	13.7	10.2	7.8
	1949	4.3	(4.7)	4.2	6.1	9.6	12.3	15.4	16.1	17.1	15.9	11.8	7.8
	1950	6.5	4.6	4.7	6.6	10.3	14.3	16.0	17.7	16.5	13.1	10.1	6.1
	1951	4.9	4.0	4.1	5.5	9.0	13.5	15.0	16.8	17.0	14.4	11.1	8.0
	1952	5.6	4.1	4.1	5.2	10.1	12.2	15.0	16.4	15.8	12.6	9.2	6.1
	1953	4.3	3.3	3.8	5.8	9.5	14.0	17.2	17.3	16.3	14.5	12.1	9.5
	1954	6.6	2.2	1.7	3.7	7.9	12.0	14.4	15.8	15.8	13.4	10.8	8.0
"P 12"							Surface						
	1948	—	—	—	(7.8)	(8.5)	13.2	15.8	17.2	15.6	13.4	(10.6)	9.7
	1949	(5.5)	4.5	3.4	(5.2)	(11.5)	13.4	15.8	16.6	16.8	15.2	10.9	7.3
	1950	5.5	4.4	4.5	7.2	12.8	13.9	16.4	18.1	16.7	12.8	9.8	5.8
	1951	4.6	3.8	4.2	5.6	8.8	13.0	15.7	16.9	16.7	14.1	11.3	8.0
	1952	5.5	3.1	3.1	4.8	9.9	13.0	15.6	16.7	15.1	11.4	8.8	5.6
	1953	3.7	2.7	3.8	6.1	10.4	14.0	16.6	17.4	16.2	14.4	12.2	9.6
	1954	5.4	1.6	1.9	4.5	8.4	13.4	15.3	16.3	15.8	13.0	10.0	7.1
"Elbe 1"							Surface						
	1948	4.2	3.1	3.9	7.0	10.7	13.1	15.8	16.3	15.6	13.0	9.5	7.1
	1949	4.6	3.3	3.2	7.1	10.2	13.2	15.7	16.8	17.0	15.0	10.2	6.4
	1950	4.5	3.6	4.5	6.9	10.0	14.1	16.9	18.3	16.4	12.4	9.0	5.0
	1951	3.4	3.0	3.3	5.6	8.6	12.6	16.0	17.1	16.6	13.4	10.6	7.5
	1952	4.8	2.7	3.1	5.7	10.3	13.7	16.4	17.4	15.5	11.6	8.7	4.4
	1953	2.8	2.0	3.7	6.2	10.1	13.2	16.9	17.4	15.6	13.8	11.8	8.5
	1954	3.8	0.8	1.7	4.6	7.7	12.4	15.4	16.2	15.7	12.6	9.2	6.8
"Weser"							Surface						
	1948	4.6	4.1	4.2	6.8	9.9	14.1	15.8	17.0	15.7	13.0	9.7	7.3
	1949	4.6	3.8	3.3	6.5	9.6	12.7	15.2	16.3	16.7	15.2	10.4	6.6
	1950	5.0	3.6	4.4	6.8	9.4	13.6	16.6	18.2	16.2	12.4	8.9	4.7
	1951	3.1	3.1	3.2	5.6	8.1	12.5	15.8	17.2	16.7	13.3	10.1	7.3
	1952	4.6	3.1	3.4	5.3	10.0	13.3	15.6	17.0	15.3	11.4	8.2	4.4
	1953	2.7	2.3	3.5	6.0	9.5	13.2	16.9	17.5	15.8	14.2	11.4	8.6
	1954	4.0	0.6	1.2	—	7.1	12.5	15.3	16.3	15.6	12.8	9.4	6.5

various depths, and then once a week. Table 4 shows the mean values of bottom observations.

The surface temperatures in 1954—especially in spring—have been extraordinarily low compared with those of the preceding years.

On the other hand, surface salinity in 1954 rarely showed extreme values apart from the month of June, which is outstanding on all lightships for unusual high monthly means.

G. DIETRICH.

**Table 5. Monthly and Annual Means of Surface Temperature at Helgoland Roads for the
Period 1872-1950.**

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Mean
1872.....	—	—	—	—	—	—	—	—	17.0	13.3	10.4	7.0	—
73.....	5.5	4.2	4.3	(6.8)	8.2	12.2	16.3	17.7	16.5	13.6	9.4	8.5	10.3
74.....	6.4	4.3	4.8	7.1	9.5	13.1	16.0	16.9	15.6	13.9	10.5	6.1	10.4
1875.....	3.7	2.2	1.6	4.3	8.5	12.8	16.3	18.3	18.2	(12.1)	(7.8)	4.1	9.2
76.....	2.5	2.5	3.3	6.1	9.0	13.2	16.3	17.7	15.7	14.9	10.0	(6.6)	9.6
77.....	(4.6)	4.1	4.1	6.0	8.1	12.7	16.1	17.3	16.0	13.0	(10.4)	7.8	10.0
78.....	5.0	3.5	4.4	5.7	8.7	13.1	15.3	17.0	16.4	14.2	9.6	5.8	9.9
79.....	1.6	0.3	0.8	2.4	6.3	10.9	13.5	17.0	15.5	13.0	9.2	5.2	9.0
1880.....	3.5	3.1	3.7	8.5	9.3	12.8	15.7	18.4	17.4	13.6	9.7	7.6	10.3
81.....	3.0	1.4	1.5	4.0	8.1	12.1	15.4	17.1	15.8	11.0	8.1	6.1	8.6
82.....	4.6	4.1	5.7	7.2	10.3	13.9	15.6	16.8	15.3	12.8	9.2	5.0	10.0
83.....	3.7	3.2	3.0	4.6	7.9	12.1	15.5	17.0	16.6	13.8	10.1	7.7	9.6
84.....	5.4	4.8	5.4	6.2	9.9	13.7	16.5	18.4	17.3	14.3	9.6	6.9	10.7
1885.....	3.4	3.4	3.7	5.6	8.4	12.5	15.9	15.9	14.6	11.8	9.3	6.3	9.2
86.....	3.0	1.8	1.2	4.1	8.4	11.6	15.4	17.4	17.6	14.6	10.9	6.9	9.4
87.....	4.1	2.9	3.2	5.3	7.9	11.6	15.9	17.2	15.4	11.7	8.5	5.7	9.1
88.....	3.5	1.9	0.5	2.4	6.8	10.8	13.4	15.2	15.3	11.9	8.4	6.3	8.0
89.....	4.2	1.8	2.1	4.6	8.3	14.6	16.4	15.5	15.3	14.0	10.4	6.3	9.5
1890.....	4.6	2.7	3.9	5.9	9.8	11.8	16.4	14.2	15.0	12.9	8.8	3.7	9.1
91.....	0.0	0.9	2.0	4.5	8.2	12.0	15.9	16.0	16.0	13.8	9.5	6.6	8.8
92.....	3.1	2.0	2.5	5.2	8.5	12.3	15.5	16.2	15.4	12.2	8.8	5.2	8.9
93.....	1.7	1.8	3.2	6.0	9.1	13.1	15.3	16.5	15.6	13.2	8.9	6.4	9.2
94.....	3.8	3.2	3.9	6.2	9.6	12.0	15.2	16.2	15.0	12.4	9.6	7.2	9.5
1895.....	3.8	0.1	1.2	4.0	8.2	12.1	15.0	16.7	16.6	13.6	9.9	5.2	8.9
96.....	3.5	2.8	2.9	5.5	9.8	13.8	15.9	16.4	15.8	13.4	9.0	6.3	9.6
97.....	3.0	1.5	1.6	5.8	9.1	13.2	14.9	16.6	15.6	13.0	9.8	6.9	9.2
98.....	5.6	4.3	3.8	5.1	8.2	12.0	14.0	15.5	15.7	13.1	10.3	7.6	9.6
99.....	5.4	4.8	4.4	5.6	8.4	12.4	15.2	16.5	15.4	12.7	10.3	6.1	9.8
1900.....	4.1	2.6	2.4	4.6	7.7	11.6	15.1	16.4	16.2	13.7	10.0	7.4	9.3
01.....	3.8	1.7	2.3	4.4	8.5	11.8	16.1	16.7	15.3	13.8	10.4	6.3	9.3
02.....	4.7	3.2	3.5	4.7	7.6	12.0	14.9	15.2	14.7	11.9	9.5	4.1	8.8
03.....	3.0	3.0	4.0	5.7	8.9	12.1	14.5	15.6	15.2	13.2	9.9	6.1	9.3
04.....	3.9	3.1	3.2	5.1	8.5	12.4	15.2	16.7	15.7	13.1	9.9	7.2	9.5
1905.....	3.8	2.7	3.6	4.9	8.5	12.4	16.1	17.0	15.7	11.2	8.3	6.1	9.2
06.....	4.2	3.2	3.3	5.6	7.8	12.5	14.6	16.5	16.1	14.2	11.2	6.8	9.7
07.....	4.2	2.0	2.6	4.8	8.6	11.6	14.2	15.3	15.1	13.6	10.5	6.4	9.1
08.....	3.0	3.0	4.0	5.7	8.5	12.4	15.2	16.7	15.7	13.0	9.9	7.2	9.5
09.....	3.9	3.2	2.7	5.1	8.5	12.4	16.1	17.0	15.7	11.6	8.2	6.1	9.2
1910.....	3.8	2.7	3.6	4.9	7.9	12.5	14.6	16.5	16.2	14.2	11.2	7.1	9.6
11.....	4.2	3.2	3.3	5.6	8.4	11.2	13.9	15.1	14.9	14.1	11.0	7.8	9.4
12.....	4.2	2.0	2.6	4.8	8.1	12.9	15.8	16.5	15.1	13.3	9.5	7.0	9.3
13.....	4.6	3.1	3.4	5.3	8.0	11.7	14.0	15.9	15.0	14.1	10.0	6.6	9.3
14.....	4.4	2.3	1.8	4.0	9.3	13.4	15.7	17.1	16.4	14.2	9.9	6.5	9.6
1915.....	4.7	4.1	4.7	6.3	9.3	12.2	15.2	17.4	16.9	13.3	9.9	7.5	10.1
16.....	4.7	3.9	4.1	5.3	9.7	12.2	15.9	16.5	14.5	12.2	9.2	7.1	9.6
17.....	4.6	2.6	3.6	6.6	8.9	12.7	15.2	15.8	16.0	13.4	11.1	7.5	9.8
18.....	4.9	3.7	4.0	6.0	8.4	12.7	14.7	16.8	14.8	12.3	9.4	7.6	9.6
19.....	5.4	3.5	3.7	4.9	8.3	12.6	14.3	15.3	15.7	12.6	7.4	4.8	9.0
1920.....	3.1	4.2	5.1	7.2	10.0	13.8	15.6	16.4	15.1	12.8	8.3	5.9	9.8
21.....	4.6	4.1	5.2	7.5	10.8	13.0	15.0	16.4	16.0	14.2	8.6	5.9	10.1
22.....	2.5	1.3	2.0	3.7	7.9	13.0	14.5	15.6	15.0	12.0	8.4	6.2	8.5
23.....	5.0	3.4	3.7	5.2	7.7	(10.1)	(14.2)	15.7	15.0	12.7	9.3	5.3	8.9
24.....	2.5	1.6	1.4	3.6	6.6	11.8	15.3	16.5	15.8	13.7	9.8	7.7	8.9
1925.....	5.6	4.9	4.5	6.4	9.6	13.5	16.1	17.0	15.4	12.7	9.2	5.2	10.0
26.....	3.6	3.5	4.4	6.5	9.4	13.0	16.6	17.2	15.8	13.0	9.9	6.6	10.0
27.....	5.4	4.4	4.8	6.6	9.0	11.8	14.8	16.8	16.2	12.8	9.6	4.6	9.7
28.....	2.7	2.7	3.4	4.8	8.4	11.4	14.8	16.2	16.2	13.8	10.8	6.6	9.3
29.....	3.2	—0.2	+0.1	2.6	7.3	10.9	14.4	15.8	16.5	13.8	10.3	7.2	8.5
1930.....	5.2	4.2	4.1	5.4	8.4	12.4	15.9	17.0	16.2	13.8	9.7	7.3	10.0
31.....	4.6	3.6	2.7	4.6	7.7	12.4	15.8	16.7	15.4	13.0	10.1	6.9	9.5
32.....	5.8	4.0	3.8	5.4	8.6	12.6	16.2	18.0	16.7	13.6	10.0	6.9	10.1
33.....	4.9	3.2	3.6	5.8	8.8	12.9	16.0	17.4	17.2	14.8	10.2	5.6	10.0
34.....	4.6	3.4	4.0	5.7	9.4	13.3	15.9	17.2	17.0	14.2	10.2	8.7	10.3

Table 5 (continued).

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Mean
1935.....	6.1	4.3	4.2	6.0	9.3	12.8	16.2	17.0	15.8	13.2	10.0	7.0	10.2
36.....	5.3	3.9	4.0	5.6	8.2	12.5	15.9	17.4	16.4	12.8	9.8	6.6	9.9
37.....	4.5	3.1	2.8	5.6	9.0	13.5	16.4	18.2	16.9	14.5	11.0	6.7	10.2
38.....	4.9	3.7	4.8	6.9	9.2	12.5	15.2	17.9	16.6	13.8	11.4	7.1	10.3
39.....	4.2	3.7	4.0	6.4	9.7	13.4	16.4	18.0	18.2	12.6	9.3	6.2	10.2
1940.....	2.5	-0.5	+0.4	3.0	7.9	12.5	15.6	16.3	14.8	12.4	9.8	6.0	8.4
41.....	2.1	1.4	1.0	3.5	6.8	11.4	16.2	16.7	15.9	13.0	7.6	6.0	8.5
42.....	2.6	-0.4	-0.2	2.3	6.6	10.4	14.2	16.3	16.4	14.2	10.6	7.1	8.3
43.....	4.6	4.4	5.1	7.1	9.9	13.0	16.4	17.1	16.8	14.2	10.6	7.1	10.5
44.....	5.2	4.0	3.8	5.7	8.8	11.7	15.0	17.4	16.1	13.7	9.6	6.7	9.8
1945*.....	(3.0)	(4.2)	(5.7)	(7.4)	(9.7)	(13.4)	(16.0)	(16.6)	16.7	14.2	11.1	7.3	10.4
46*.....	5.0	3.8	3.0	6.4	8.5	12.0	16.4	16.8	16.5	13.3	10.4	6.7	9.9
47*.....	1.5	-1.2	-0.5	3.7	7.4	12.8	16.5	18.0	18.0	13.6	10.0	6.4	8.8
48*.....	5.0	4.4	3.7	6.7	9.9	12.6	15.1	15.5	15.8	13.6	10.6	8.4	10.1
49*.....	5.5	4.0	3.3	6.6	9.3	12.2	15.0	16.2	17.2	15.4	11.4	7.5	10.3
1950*.....	5.5	4.6	4.3	6.5	9.3	13.2	16.2	17.7	16.7	13.3	10.4	6.0	10.3

* 1945—1950 from correlation with lightship "Elbe 1".

Mean Values of Temperature and Salinity derived from periodic Observations made at Helgoland Roads.

For the investigation of the variations of temperature and salinity at the surface of the German Bight only the standard observation series of Helgoland Roads is available. In Table 5 monthly and yearly mean values are given of the surface temperature for the period from 1872—1950 and in Table 6 the corresponding values of the salinity at the surface for the period from 1873—1944. The following sources served as a basis for the compilation of the Helgoland observation series:—

- t°C.—and S⁰/₀₀—monthly and yearly means from 1872 to 1893 derived from daily observations according to KARSTEN (1896)¹;
- t°C.—and S⁰/₀₀—monthly and yearly means from 1893 to 1907 derived from daily observations according to REICHARD (1913)²;
- t°C.—and S⁰/₀₀—monthly and yearly means from 1907 to 1936 (according to the author) from daily observations made by the "Staatliche Biologische Anstalt" on Helgoland³;
- t°C.—and S⁰/₀₀—monthly and yearly means from 1927 to 1936⁴) and from 1937 to 1944 derived from routine observations of the "Staatliche Biologische Anstalt" on Helgoland (observation scheme of the German lightships);
- t°C.—monthly and yearly means from 1945 to 1950 according to the author⁵).

In order to be able to compare the mean salinity values for the period from 1872—1936 (KARSTEN, REICHARD, GOEDECKE), which had been computed from density determinations with the aid of an areometer, with those determined by titration (KNUDSEN method) for the period from 1927—1944, a mean correction factor has been computed based on simultaneous measurements made from 1927—1936 (areometer and KNUDSEN) and applied to the mean values gained for the period from 1873—1936. By this means it appears that the entire Helgoland salinity series in its first approximation is nearly homogeneous. On the method of computing and on the value of this salinity correction factor details will be found in a separate paper⁵).

ERICH GOEDECKE.

¹) G. KARSTEN, 1896, Wissensch. Meeresunters., N. F., 1, 2, Kiel und Ergebn. d. Beob. Stat. an d. deutschen Küsten usw. 1873—1893.

²) A. C. REICHARD, 1913, Wissenschaftl. Meeresunters. d. Biolog. Anst. Helgoland, N. F., 10, 1, Kiel und Leipzig.

³) E. GOEDECKE, 1952, Ber. Dtsch. Wiss. Komm. Meeresforsch., 13, 1, pp. 1—31, Stuttgart.

⁴) E. GOEDECKE, 1939, Annalen d. Hydr. usw. 67, H. IV, S. 161, Berlin.

⁵) E. GOEDECKE, 1955, Ber. Dtsch. Wiss. Komm. Meeresf. (in the press).

Table 6.

Monthly and Annual Means of Surface Salinity at Helgoland-Roads for the Period 1873-1944.

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Mean
1873.....	35.9	35.6	35.5	33.9	—	—	—	33.7	34.2	—	—	33.1	(34.6)
74.....	33.2	32.4	33.0	31.4	31.1	31.6	31.6	32.4	32.9	34.0	33.5	33.9	32.6
1875.....	34.6	33.9	34.2	34.2	31.9	32.3	32.1	32.0	33.0	(35.2)	(34.5)	32.8	33.4
76.....	32.9	(33.5)	32.3	30.5	31.7	31.8	32.6	32.6	32.2	33.2	(32.8)	—	(32.4)
77.....	34.5	33.3	30.0	33.0	31.3	32.2	31.8	31.3	31.0	31.0	—	32.7	(32.0)
78.....	32.3	31.5	30.0	29.8	31.8	32.3	31.0	30.9	31.3	31.8	32.3	31.9	31.4
79.....	32.3	32.2	31.3	31.3	30.0	31.0	31.2	33.6	31.8	31.5	30.5	31.2	31.5
1880.....	31.1	32.0	31.4	33.4	31.3	31.8	32.4	31.7	33.5	33.3	33.1	32.3	32.3
81.....	30.3	33.1	32.1	30.9	31.3	31.5	31.6	32.0	32.9	33.6	34.0	34.5	32.2
82.....	33.7	33.2	32.3	33.5	33.1	33.0	33.4	33.0	32.7	34.4	34.2	33.6	33.3
83.....	34.3	33.7	31.7	32.8	32.7	32.2	33.2	33.0	32.9	33.8	34.0	33.5	33.2
84.....	32.9	33.3	34.5	33.5	33.3	32.2	32.4	32.7	33.7	33.6	33.3	33.6	33.3
1885.....	34.9	34.9	32.7	32.6	33.8	32.4	31.9	31.9	32.4	33.5	34.7	34.2	33.3
86.....	32.7	32.6	33.6	31.8	30.3	31.3	31.4	31.5	31.8	32.7	33.5	32.8	32.2
87.....	33.9	33.9	33.4	31.9	31.1	31.3	31.0	31.2	32.2	31.8	32.3	32.4	32.2
88.....	32.6	32.0	32.7	30.5	30.2	30.1	30.6	30.3	31.2	30.6	31.4	31.5	31.1
89.....	32.9	31.3	31.3	31.0	32.5	31.9	31.8	31.7	31.7	32.2	33.0	33.1	32.0
1890.....	32.7	32.9	33.0	31.9	31.8	31.2	31.8	31.6	32.0	31.2	32.6	32.9	32.1
91.....	32.7	32.6	31.4	30.6	32.3	31.8	31.1	31.6	31.8	33.6	34.3	33.9	32.3
92.....	33.2	32.6	32.7	31.9	31.0	30.9	30.8	31.2	31.6	32.4	33.4	33.5	32.1
93.....	32.58	32.69	(32.00)	28.86	30.22	30.49	31.12	31.31	31.19	32.26	32.16	33.19	31.51
94.....	34.05	32.72	31.97	32.79	31.74	31.96	31.87	32.27	31.76	31.64	32.50	32.40	32.25
1895.....	31.79	31.53	32.18	30.52	30.93	30.68	30.85	31.25	30.94	31.13	32.13	32.09	31.34
96.....	32.42	32.21	31.57	27.84	28.42	28.96	29.68	30.10	31.94	32.42	32.34	32.93	30.90
97.....	33.02	32.95	32.00	28.65	29.76	30.52	30.99	31.42	31.62	31.65	32.50	32.57	31.55
98.....	32.69	30.92	31.18	31.45	31.50	31.21	30.95	30.91	30.81	31.96	32.83	32.26	31.56
99.....	32.23	32.78	32.34	32.16	31.14	31.15	30.88	31.29	31.58	32.67	32.16	31.82	31.85
1900.....	32.83	32.62	31.48	31.41	30.97	30.95	31.11	31.84	31.73	31.85	32.93	33.49	31.94
01.....	33.43	32.33	31.78	32.21	31.28	31.91	31.13	31.96	32.19	32.11	31.69	31.44	31.96
02.....	31.17	32.07	32.88	32.11	31.31	31.22	31.24	31.15	31.22	31.93	32.79	33.05	31.85
03.....	33.45	32.83	33.12	31.81	30.74	31.55	32.38	32.39	32.15	32.86	32.33	33.10	32.29
04.....	34.28	33.60	32.39	32.56	32.14	31.99	31.62	31.68	32.48	32.67	32.48	33.12	32.58
1905.....	32.33	31.92	33.09	32.36	31.55	32.05	32.03	32.11	32.47	32.11	32.98	33.34	32.36
06.....	33.59	32.48	30.73	29.48	31.16	30.75	30.44	30.57	30.64	31.62	32.60	32.06	31.34
07.....	33.24	32.90	31.10	31.97	31.13	31.90	31.51	30.59	31.11	32.65	33.76	33.73	32.07
08.....	33.47	32.81	33.02	31.78	31.83	32.00	31.63	31.68	32.50	32.67	32.48	33.10	32.41
09.....	34.28	33.69	32.40	32.53	31.54	31.72	32.04	32.12	32.46	32.13	32.99	33.34	32.60
1910.....	32.35	31.94	33.11	32.81	31.18	30.77	30.40	30.59	30.63	31.62	32.61	32.07	31.67
11.....	33.60	32.46	30.72	29.51	31.11	31.89	31.18	30.59	31.09	32.68	33.70	33.74	31.86
12.....	33.24	32.89	31.10	31.98	31.98	31.12	31.35	31.29	31.90	33.17	34.06	34.03	32.34
13.....	33.77	32.53	32.64	32.12	31.47	31.18	31.78	31.28	31.73	32.98	32.55	33.16	32.43
14.....	33.79	33.00	32.95	32.33	30.60	31.27	31.59	31.08	30.55	31.56	32.56	33.00	32.02
1915.....	32.89	32.75	31.61	29.99	30.70	31.34	31.42	31.47	31.66	31.91	32.21	33.46	31.78
16.....	32.83	31.14	30.46	31.24	31.39	31.35	32.06	32.89	32.07	32.74	33.51	32.45	32.01
17.....	33.16	32.95	32.70	30.91	32.52	31.92	31.42	31.39	31.29	32.85	33.87	31.38	32.20
18.....	32.96	33.11	32.55	31.91	32.72	31.94	31.69	31.56	31.72	32.27	(33.21)	33.55	32.43
19.....	33.07	32.73	32.67	31.98	31.36	31.37	31.65	31.02	31.71	32.39	32.84	33.21	32.17
1920.....	32.45	31.50	31.72	32.59	31.99	30.54	31.53	31.91	31.88	33.44	33.83	33.89	32.27
21.....	32.93	31.62	32.40	31.92	31.49	32.40	31.98	32.01	32.24	32.45	32.61	32.90	32.25
22.....	32.69	33.84	31.84	31.16	31.80	31.33	31.86	31.49	31.42	32.16	31.79	31.29	31.89
23.....	31.98	31.92	32.43	32.61	32.27	(30.96)	(30.68)	30.73	31.83	32.38	32.80	32.46	31.92
24.....	32.96	32.91	32.46	30.43	31.50	31.23	30.79	31.24	32.04	32.76	32.74	33.14	32.02
1925.....	32.27	32.01	31.07	31.34	31.99	32.12	31.45	31.90	31.37	31.30	31.76	32.46	31.75
26.....	32.11	32.42	29.49	31.87	31.21	32.29	30.18	30.26	30.02	30.75	32.14	31.71	31.20
27.....	31.62	32.57	32.40	31.10	28.65	28.91	30.37	32.25	32.47	31.31	32.68	33.37	31.48
28.....	33.34	32.56	33.13	32.92	31.98	31.37	31.22	31.58	31.40	32.31	32.64	32.21	32.22
29.....	32.55	33.93	33.52	31.23	30.22	31.61	31.57	32.16	31.74	32.22	32.62	33.35	32.23
1930.....	33.47	33.27	33.76	33.80	32.81	32.89	33.15	32.72	32.54	32.79	31.35	32.58	32.93
31.....	32.04	32.33	31.36	30.92	32.27	31.76	31.55	31.32	30.78	30.72	31.57	31.82	31.62
32.....	32.10	30.41	31.46	32.35	32.21	30.78	31.42	31.55	31.69	32.51	32.97	33.35	31.90
33.....	33.66	32.84	33.30	30.96	31.20	31.91	31.92	32.00	31.62	32.29	32.80	32.92	32.29
34.....	33.36	32.57	32.78	30.40	32.65	31.83	31.99	32.17	32.70	32.77	32.98	33.95	32.51
1935.....	34.40	33.30	33.15	32.10	30.76	31.83	31.52	31.54	31.85	32.23	33.05	33.73	32.46
36.....	33.33	32.52	32.47	31.26	31.13	31.35	32.63	32.17	31.95	31.56	32.18	32.47	32.09

Table 6 (continued),

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Mean
1937.....	32.72	33.53	31.93	31.74	30.45	30.77	31.00	30.49	31.49	32.01	32.95	33.14	31.85
38.....	33.11	31.05	31.12	29.65	30.29	30.95	31.36	31.50	31.85	32.22	32.66	33.80	31.63
39.....	33.40	32.74	32.24	31.52	31.47	31.96	32.48	32.40	32.50	33.34	33.35	32.04	32.45
1940.....	31.94	33.23	32.38	31.48	30.72	30.57	31.90	31.14	30.76	31.58	32.64	32.00	31.70
41.....	32.94	33.72	31.10	30.89	31.13	30.77	30.51	31.79	31.38	31.72	31.46	31.96	31.61
42.....	32.31	32.81	33.57	32.87	32.13	32.34	31.48	31.52	32.22	32.07	32.13	31.81	32.27
43.....	33.09	32.54	31.97	31.53	32.31	32.81	32.18	32.34	32.70	33.37	33.68	33.67	32.68
44.....	33.02	31.63	31.40	31.19	30.09	30.74	31.19	31.70	32.66	—	—	—	—

Hydrographic Conditions in the Southern North Sea, the Bløden Ground Area in 1954.

The Danish investigations in the Bløden ground area were made this year in the months May—September. The M/C “Jens Væver” has taken observations in June, July and August and the R/V “Dana” has worked in the area in May and September.

A good picture of the summer development of bottom conditions is in this way available and this is illustrated in Figures 12—17. The main features are very much similar to those of 1953, as the 1954 picture of the semi-stationary cold tongue north and east of the Dogger Bank is very analogous to that of 1953. The May temperature of the cold tongue was about 5.5° , whereas the surrounding bottom waters had temperatures of 6° — 7° . In September the corresponding temperatures were 9° and 15° — 16° . This is also very similar to 1953.

The September observations are divided in two as the work was interrupted by a strong gale, and in this way the Figures 16 and 17 demonstrate the effect of the mixing caused by the strong wind.

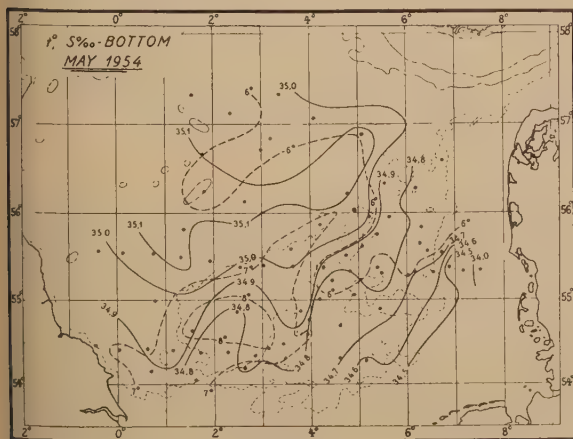
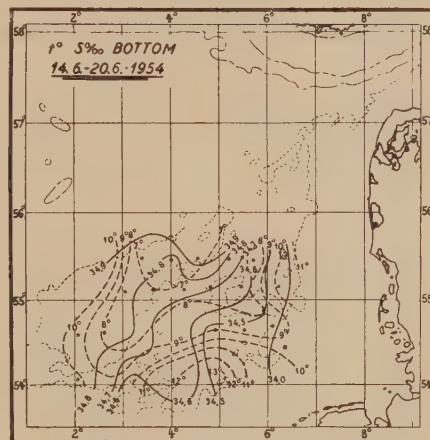


Figure 12.



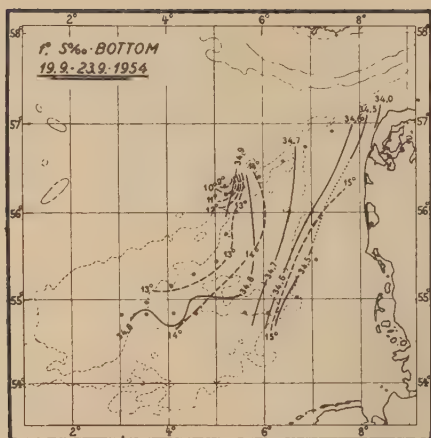


Figure 16.



Figure 17.



Figure 18.



Figure 19.



Figure 20.

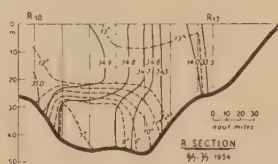


Figure 21.



Figure 22.



Figure 23.

Phosphate and oxygen determinations were carried out in May and September, and it was found that the cold tongue is richer in phosphate than the surrounding waters at the bottom. As regards oxygen the May observations show that the bottom water was saturated or supersaturated all over the area in this month. In September before the gale the situation was very different as the cold tongue had an oxygen saturation percentage of 70–80, while the corresponding number was about 95

for the surrounding bottom water. After the gale, which caused the cold tongue to almost disappear, the bottom waters were almost saturated with oxygen. Figures 18–23 show temperature and salinity distributions at the international R-section in the various months together with an S-section from May. The sections give a good picture of the vertical development which was similar to that of 1953.

KNUD P. ANDERSEN.

Table 7. Monthly Means of Salinity and Temperature at Surface and Bottom at the Lightvessel "Vyl" for a longer Series of Years, and Deviations from these Means.

(From the Danish Meteorological Institute, Nautical Department.)

Month:	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity												
Mean.....	32.6	32.4	32.2	32.4	32.3	32.6	32.5	32.4	32.6	32.4	32.4	32.9
1954.....	0.8	1.4	2.2	1.8	1.6	—	0.7	0.8	0.4	0.8	1.3	0.8
Bottom												
Mean.....	33.0	32.8	32.7	32.8	32.6	33.1	32.9	32.6	32.7	32.6	32.6	33.0
1954.....	0.8	1.1	1.8	1.5	1.4	—	0.6	0.9	0.6	1.0	1.4	1.0
Temperature												
Surface												
Mean.....	3.2	2.2	2.6	4.8	8.8	12.4	15.2	16.1	15.0	12.2	8.5	5.4
1954.....	1.9	—1.0	—0.3	—0.6	—0.6	—	—0.9	—0.5	0.4	0.6	1.6	2.0
Bottom												
Mean.....	3.9	2.6	3.0	4.7	7.9	11.1	14.1	16.0	15.1	12.7	9.1	6.2
1954.....	1.4	1.3	—0.7	—0.6	—0.3	—	—0.3	—0.5	0.4	0.3	1.2	1.5

H. THOMSEN.

Hydrography of the Kattegat Area.

Danish Waters. (Table 8).

A continuous frost period from 22. January to 26. February caused a strong cooling of the surface water and extensive ice formations. The extension of the ice culminated by the end of February. By that time there was heavy fast ice in all fjords, bays, and other protected fairways and drift-ice in the Kattegat. From the beginning of April the fairways were again free of ice.

In Kattegat the salinity was generally above normal, especially in April and July.

The temperature was slightly above normal in January, but the severe winter caused low temperatures in February and March. Near the bottom low temperatures persisted during the following months, but at the surface the

temperature had reached normal values in April, and in May and June surface temperatures were slightly above normal. In July and August the surface temperatures were about 1°C. lower than normal, about normal in September and October, and slightly above normal in November and December.

H. THOMSEN.

Swedish Waters.

During 1954 the surface salinity was found to be somewhat higher than the mean values 1923—52, particularly at "Vinga" (Table 9). The bottom salinity was quite normal at "Vinga" whereas "Svinbådan" displayed a positive deviation in March-July followed by a marked deficit obviously due to supply of Baltic water.

Table 8. Monthly Means of Salinity and Temperature at Surface and Bottom at the Lightvessel "Anholt Nord" for a Series of Years, and Deviations from these Means.

(From the Danish Meteorological Institute, Nautical Department.)

Month:	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity						Surface						
Mean.....	23.5	23.1	20.2	19.2	18.1	18.9	19.4	20.1	20.7	20.7	21.9	22.8
Deviation 1954.....	1.5	—	(-1.3) ¹⁾	3.6	1.7	-0.9	2.6	1.7	(1.7) ²⁾	3.2	2.1	-0.1
						Bottom						
Mean.....	31.8	32.0	32.5	33.0	33.1	32.8	32.3	31.9	31.8	32.2	32.4	32.1
Deviation 1954.....	1.0	—	(1.4) ¹⁾	0.9	0.7	1.3	0.1	1.3	(0.9) ²⁾	0.7	0.3	0.9
Temperature						Surface						
Mean.....	2.2	1.4	1.9	4.5	9.4	14.2	16.8	16.7	14.5	10.9	7.1	4.1
Deviation 1954.....	1.3	—	(-1.1) ¹⁾	0.0	1.3	1.4	-1.2	-0.8	(-0.1) ²⁾	0.0	1.1	1.2
						Bottom						
Mean.....	6.1	4.7	4.3	4.3	4.9	6.7	9.7	12.7	13.1	12.1	10.2	8.1
Deviation 1954.....	1.2	—	(-1.2) ¹⁾	-2.1	-1.7	-0.8	0.9	0.2	(0.2) ²⁾	1.2	1.2	-0.1

1) Observations 12.—31. only. 2) Observations 1.—9. and 19.—30. only.

Table 9. Monthly Means of Salinity and Temperature in 1954 at Surface and Bottom for the Swedish Lightships "Vinga" and "Svinbådan", and Deviations from Normal Values (Mean Values 1923-52).

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity												
"Vinga".....	27.4	—	—	24.4	22.6	21.2	23.1	23.2	25.4	25.4	24.6	25.0
Deviation.....	+2.4	—	—	+1.9	+1.5	+0.6	+1.2	+1.7	+2.4	0.0	-0.6	+0.4
"Svinbådan".....	17.4	—	16.7	13.9	11.7	14.0	14.9	11.9	17.3	16.8	16.1	18.3
Deviation.....	+1.4	—	+2.9	+0.4	-0.1	+0.4	+1.7	-1.0	+3.3	+1.3	+0.6	-2.2
Bottom												
"Vinga".....	34.0	—	—	34.5	34.6	34.5	33.7	33.6	33.4	33.5	33.5	34.0
Deviation.....	+0.3	—	—	+0.3	+0.2	+0.4	-0.1	-0.1	-0.5	0.0	-0.5	+0.2
"Svinbådan".....	24.9	—	34.5	32.2	33.5	33.1	31.1	21.2	27.1	27.2	27.3	27.2
Deviation.....	-5.5	—	+3.9	+0.6	+1.4	+1.8	+1.3	-8.5	-2.3	-2.0	-2.9	-2.5
Temperature												
Surface												
"Vinga".....	3.8	—	—	4.4	10.9	15.4	15.6	16.1	14.6	10.8	7.5	5.5
Deviation.....	+1.1	—	—	-0.5	+0.7	+0.8	-1.8	-1.9	-0.8	-0.6	-0.2	+0.8
"Svinbådan".....	2.7	—	1.5	4.1	10.2	16.2	15.7	15.3	14.7	10.6	7.5	5.1
Deviation.....	+0.3	—	-0.5	-0.3	+0.9	+2.4	-1.1	-2.0	-0.2	-0.4	0.0	+0.9
Bottom												
"Vinga".....	7.3	—	—	3.5	6.3	7.5	11.6	12.1	13.8	12.4	10.4	7.9
Deviation.....	+1.2	—	—	-1.5	+0.8	-0.3	+2.3	+0.9	+1.8	+0.6	+0.9	0.0
"Svinbådan".....	4.8	—	6.7	5.0	4.9	5.1	7.3	11.2	12.1	11.4	10.2	7.5
Deviation.....	-1.8	—	+2.0	-0.1	-1.0	-1.9	-2.1	+0.2	+0.1	-0.1	-0.5	-1.0

The fairly cold weather in July and August is reflected in the surface temperatures. Most bottom temperatures are associated with the bottom salinities. In particular it is noticed that the above-mentioned high-salinity water at "Svinbådan" had a relatively low temperature.

NILS JERLOV.

Hydrography of the Norwegian Skagerak Coast.

The sea temperature and density at a depth of one metre is observed every working day at Flødevigen near Arendal.

In 1954 the sea temperature was extremely high in January and low in February and March. (See Table 10).

Table 10.

Average	Jan.	Febr.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1919—29 ...	3.06	1.60	2.33	4.63	8.8	12.28	15.52	15.63	13.94	10.84	7.14	4.70
1030—39 ...	3.41	2.73	2.34	4.79	9.39	13.34	16.61	17.37	14.95	11.45	8.09	5.22
1940—49 ...	2.69	1.67	1.87	4.36	9.46	13.38	16.84	16.99	15.04	11.73	8.11	5.86
1950.....	3.6	2.2	3.2	5.8	10.8	13.0	16.1	17.5	15.1	12.2	7.6	4.6
1951.....	1.3	1.1	1.0	3.6	8.8	13.5	15.0	16.1	15.1	12.6	8.5	7.4
1952.....	5.2	3.1	2.1	4.5	9.8	11.2	14.6	15.9	13.6	9.6	6.0	4.2
1953.....	2.8	2.6	3.2	5.3	9.9	15.6	16.4	16.5	14.7	12.3	9.1	7.0
1954.....	5.5	0.9	0.4	4.1	9.6	13.4	15.3	15.7	14.6	11.0	7.6	5.5

ALF DANNEVIG.

Plankton.

Plankton Collections by the Scottish Research Vessels.

Plankton samples were taken by the Scottish research vessels during all cruises throughout the year. Reports are also given to the Distant Northern Seas and Atlantic Committees.

Phytoplankton.

The inshore spring diatom outburst was well evident in March when the dominant species was *Skeletonema costatum*. Offshore the con-

centration was less and the chief species was *Thalassiothrix nitzschoides* with *Coscinodiscus* and *Chaetoceros* spp. in the north. A specific change occurred by April when *Skeletonema* became reduced and *Thalassiosira gravida* increased in the north-western North Sea area together with *Chaetoceros* spp. near Shetland and *Nitzschia seriata* in the central North Sea. *Rhizosolenia hebetata* occurred commonly off the Norwegian coast and *Rh. styliformis* in the Fair Isle area. By May dinoflagellates ha-

become more abundant inshore but the diatoms still flourished offshore, with *Rh. alata* var. *gracillima*, *Chaetoceros decipiens* and *C. convolutus* dominating. In June the dinoflagellates became abundant in the North Sea collections, forming about 80% of the phytoplankton; the dominant species was *Ceratium longipes*. There was still a fair proportion of diatoms in the open ocean with *Ch. decipiens* predominating in the Faroe Channel.

The summer minimum was noted in July when diatoms became very scarce and dinoflagellates were less numerous. The latter increased rapidly in August with *C. tripos* dominant in the central part of the northern North Sea. *C. fusus* and *C. longipes* were most abundant near Shetland. *Rhizosolenia alata* was still present near Shetland but many dead specimens were taken. Dinoflagellates reached their peak in September when *C. macroceros* was the most abundant species and it occurred in particularly large numbers east of Fair Isle. Diatoms also increased, from about 30 to 1,250 per litre, the commonest being *Ch. decipiens*. A number of species reached their maximum in September, and these included *Ch. decipiens* and *Ch. convolutus*, *Rh. alata*, *Guinardia flaccida* and *Coscinodiscus concinnus*, as well as the bulk of the dinoflagellates, *Ceratium longipes* being the chief exception. Specimens of *Rh. alata* were taken which were var. *gracillima* at one end and var. *indica* at the other. The autumn increase had considerably died down by October although *Coscinodiscus concinnus* and *Halosphaera* were found with a few individuals of other species.

The oxygen and phosphate figures associated with the phytoplankton distributions are given by JOHNSTON (see p. 11).

Zooplankton.

The autumn influx of 1953 brought many oceanic species to the area east of Shetland with penetration off the east Scottish coast as far south as 57°. A little of this survived even after December but it was also augmented in the north by a continuance of the inflow. The plankton of the Shetland and Fair Isle area was thus kept oceanic in character, with *Sagitta serratodentata*, *Chelophyes*, *Agalma*, *Galettia* and *Rhincalanus* etc. being brought in from the Faroe-Shetland Channel up to April; but the Moray Firth and inshore areas off the Scottish coast soon lost their oceanic indicators. The autumn conditions in the northern North

Sea in 1953 left an environment well suited to the development of the spring outburst and by April a rich population of *Calanus* had developed. This was generally maintained until July with extension to August or even September in some local areas. There was also a secondary influx of *Calanus* from August to October via the north of Shetland, but this was confined to the deeper layers. The penetration of this brood into the northern North Sea extended south to at least 57°N. although it was well to the east of the Moray Firth and east Scottish coasts—east of 0°30' W. Inshore waters were very poor in crustaceous plankton but *Pleurobrachia* was extremely abundant in the autumn.

Most species of Chaetognatha were unusually scarce throughout the year, especially to the north and west of Scotland, but *S. setosa* was present in moderate numbers on the north-eastern side of the North Sea, extending in the surface layers over the Norwegian Deep—i.e., in the Baltic outflow—at least as far as 61°N. The autumn brood of *S. elegans* became well marked off the east Scottish coast after being scarce all summer. Rare records in 1954 include *S. bipunctata* to the north-west of Shetland 61°14'N., 2°40'W. in April, and *Krohnitta subtilis* east of Rockall at 58°07'N., 10°10'W., in May.

The south-western part of the Near Northern Sea area, i.e., between Rockall and Scotland, was investigated in May, July and August. This showed a Lusitanian fauna, confined to 250 m. and below, which penetrated northwards into the Faroe-Shetland Channel. The species represented included numbers of *Leusie fowleri* with *Hippopodius*, *Vogtia spinosa* and *V. glabra*, *Bassia bassensis*, *Praya*, *Pelagia*, *Rhopalonema*, *Vanadis formosa*, *Iasis zonaria*, *Sagitta lyra*, *Clio polita*, *Euphausia krohni*, *Stylocheiron longicorne* and *S. maximum*, *Nematoscelis megalops*, *Nematobrachion boopis*, *Vibilia pyripes* and *Phronima sedentaria*. A specially interesting record is that of the large diatom *Ethmodiscus gazellae* found at 57°00' N., 11°00' W., in August; it was recorded in the North Atlantic off the English Channel in 1953. The surface layers had a plankton fauna typical of the North Atlantic Drift with *Salpa fusiformis*, *Cosmetira*, *Laodicea*, *Leusie conoidea*, *Dimophyes arctica*, *Galettia biloba*, *Agalma*, *Arachnactes*, *Rhincalanus*, etc. Both the Lusitanian and the North Atlantic Drift fauna entered the Faroe-Shetland Channel, the former

being taken on the southern half only of the line between the Hebrides and Faroe. Thereafter there was considerable mixing so that the fauna entering the North Sea was very mixed and it also contained fauna of definite boreal origin, including *Calanus hyperboreus*, *Metridia longa* and *Themisto libellula*, the last-named being particularly interesting so far south.

Salpa fusiformis became generally dispersed in the northern North Sea, and was common in a tongue extending between $0^{\circ}30'W.$ and $1^{\circ}E.$ where it was accompanied by *Agalma*, *Galettia*, *Clio pyramidata*, *Rhincalanus* and other general oceanic species, together with a Lusitanian admixture. These latter included *Vellela* and *Clio cuspidata* found as far south as about $57^{\circ}N.$ in September, *Phronima sedentaria* to $58^{\circ}N.$, *Fierasfer* to $58^{\circ}30'N.$ and *Praya* to $59^{\circ}N.$ in November. The salp *Ihlela asymmetrica* was common at times outside the North Sea but there is no evidence that it reached there, nor apparently did *Lensia fowleri*, *Vanadis*, *Iasis zonaria*, nor even *Pelagia* which has so often penetrated in numbers. There was some inflow of oceanic species via the Fair Isle Passage (by *Salpa fusiformis*, *Arachnactes*, etc.) but the bulk of the inflow of organisms came via the north of Shetland.

There are thus similarities and differences between 1953 and 1954. The route of the oceanic species was essentially similar in both years and the east Shetland area became flooded with salps; the autumn inflow of plankton into the North Sea in 1954, although reaching approximately the same degree of penetration as in 1953, was nevertheless of a more mixed origin and associated with a weaker water movement. As in 1953, the salp invasion was associated with the failure of the Shetland herring fisheries after the dominant non-spawning stock left there in May/June; the local autumn-spawning race was present in only small numbers, possibly because of these environmental conditions. In 1953 the Lusitanian fauna was found abundantly both east and west of Rockall and dominated the inflow into the North Sea. It was accompanied by a marked dearth of crustaceous plankton. In 1954 the Lusitanian fauna was largely found only to the east of Rockall and the normal fauna of the North Atlantic Drift was dominant in the Faroe-Shetland Channel. This oceanic inflow was not sparse in crustacea and *Calanus* was plentiful in places in sub surface layers to the east of the normal herring grounds along

with young euphausiids, mostly *Thysanoessa inermis* but also *Meganyctiphanes*, *Th. rasch* and *Nyctiphanes couchii*. This population was also rich in decapod larvae. Dense local shoals of *Themisto* occurred at the surface and *Limacina retroversa* was also abundant and very dense indeed near Fair Isle in July and on the Fladen in August. *Nephrops* larvae were fairly widespread over the northern North Sea in June and lobster larvae were taken in the Orkney and Moray Firth areas in September. The inflow into the Moray Firth was not appreciable in either year and indeed in that region and in the area between Shetland and the Scottish east coast plankton was poor.

J. H. FRASER.

The Continuous Plankton Recorder Survey Plankton around the British Isles during 1954

The scope of the Recorder survey was similar to that in previous years¹). However owing to a rearrangement of tours of duty of the international weather stations, sample were taken over some unusual routes. I

¹) Ann. Biol., 5-10.



Figure 24. A chart showing the Continuous Plankton Recorder routes which are used in this summary. In subsequent figures and in the text they are referred to by their code letters H, J, W, X, V, T, A and K. The broken lines, X', and T' show the alternative routes taken by the weather ship in certain months (see also text).

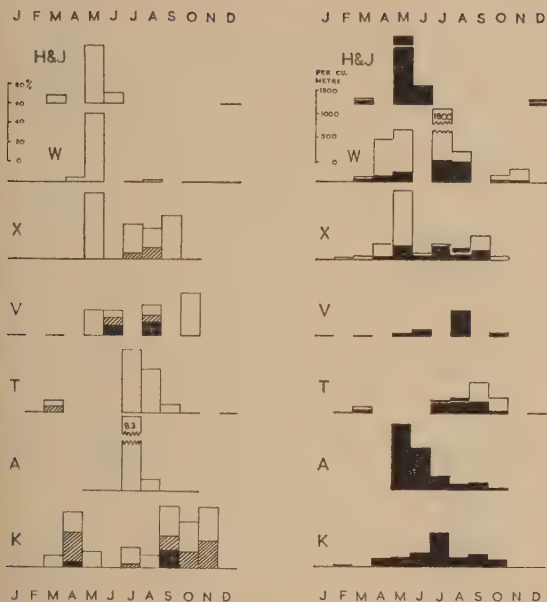


Figure 25. An estimate of the density of *Phytoplankton* month by month on the Recorder routes, H & J, W, X, V, T, A and K. The histograms show the percentage of the route which sampled water containing various quantities of phytoplankton as estimated by comparing the colour of the filtering silk with an arbitrary colour scale; only that part of the record taken outside the 100-fathom contour is included on H & J, W, X, V and T. The open part of the histogram represents "pale green", the hatched part "green" and the blacked part "dark green". A gap in the base line indicates that no data were available in the particular month.

Figure 26. Histograms representing the relative numbers of *Total Copepoda* (all species combined) taken month by month on the Recorder routes H & J, W, X, V, T, A and K. The values represent the number of copepods per cubic metre either for the whole length of tow on routes A and K or for the two parts of the tow which lie on either side of the 100-fathom contour on routes H & J, W, X, V and T when the solid histogram shows the numbers over the deeper water and the open histogram over the shallower or coastal water. A gap in the base line indicates that no data were available in the particular month.

Figure 24, the standard routes previously used in these summaries are shown as solid lines whereas the alternative routes T', V' and X' are indicated by broken lines. T' was sampled in July, August, September, October and December; V' in June, August and October; and X' from January to June inclusive. The other records used were taken on the standard routes. As the Netherlands weatherships stood several watches on Station M, the two most southerly Atlantic routes were poorly sampled; H only in March and December, and J only in May and June.

The very superficial estimation of phytoplankton based on the green colouration of the filtering silk (Figure 25) suggests that 1954 was an "average" year for diatoms. In May, phytoplankton was widespread over the deeper parts of the Atlantic routes but nowhere dense. Again on the inshore ends of these routes (not illustrated) the flowering was somewhat earlier, good crops of *Thalassiosira* spp. and *Thalassiothrix nitzschoides* being established on W and T as early as March. Some of the colouration in mid-summer, that on A and T in July and August, was attributable to dinoflagellates. On K there was clear indication of the spring and autumn flowerings.

Taking the copepods as a whole (Figure 26), 1954 was an extremely poor season over most of the area sampled; by and large, the average figures were lower than during any of the previous six years. This was particularly noticeable in the North Sea where the rich spring population usually found on K in April or May failed to materialize. However, off the Moray Firth, on the A route, the reverse was

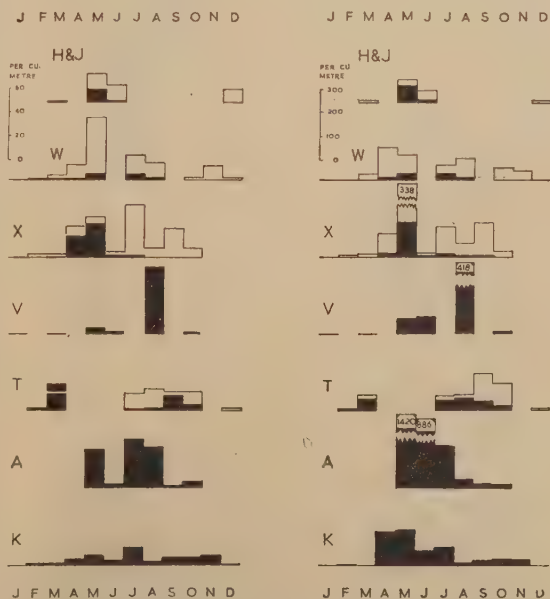


Figure 27. Histograms representing the relative numbers of *Large Calanus* (copepodid stages V and VI) taken month by month on the Recorder routes H & J, W, X, V, T, A and K. Details as in Figure 26.

Figure 28. Histograms representing the relative numbers of *Calanus* (all stages combined) taken month by month on Recorder routes H & J, W, X, V, T, A and K. Details as in Figure 26.

the case; unprecedentedly high numbers of copepods were taken there in May and June. Unfortunately, no data were available on this route earlier in the year.

The general scarcity of copepods was reflected in *Calanus* (Figures 27 and 28). In the summary for 1953¹⁾ comment was made on how consistent the maximum average numbers of *Calanus* in each year had been. In almost every spring, or early summer, they had attained something of the order of 500—600 per cubic metre on K and 700—900 on T. During 1954, T was inadequately sampled but at no time did the average number on K exceed 150 per m.³ On the A route, however, averages have not exceeded 200 in the past, but during 1954 in April and June 1,420 and 886 respectively were recorded there.

Euchaeta spp. (Figure 29) were also less abundant than in recent years, but nevertheless they were taken in reasonable numbers on the two Atlantic routes, W and X, in April. This

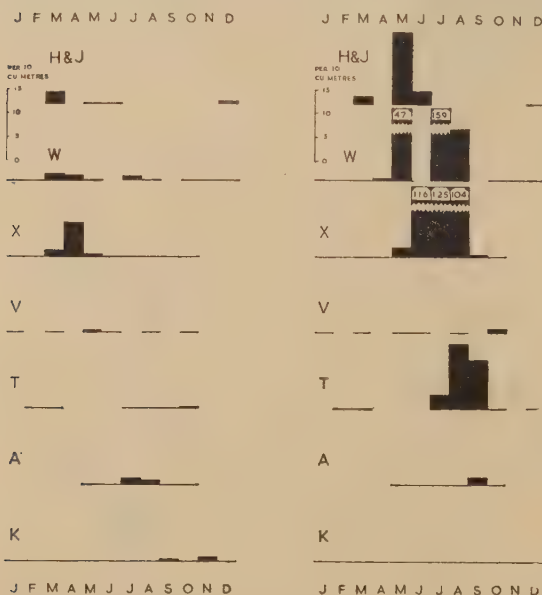


Figure 29. Histograms representing the relative numbers of *Euchaeta* spp. taken month by month from the Recorder routes H & J, W, X, V, T, A and K. Only that part of the tow taken outside the 100-fathom contour is included on routes H & J, W, X, V and T; otherwise details as in Figure 26.

Figure 30. Histograms representing the relative numbers of *Metridia lucens* taken month by month from the Recorder routes H & J, W, X, T, V, A and K. Only that part of the tow taken outside the 100-fathom contour is included on routes H & J, W, X, V and T; otherwise details as in Figure 26.

conforms to the results for 1951, 1952, and 1953; previously, 1948, 1949, and 1950, their appearance was restricted to the autumn and winter months. The species included in this composite group undoubtedly have a normal habitat well below the 10 metre depth sampled by the Recorder. Presumably they only appear in our catches at the time of their seasonal migration towards the surface. It would seem, nevertheless, that there has been some significant change in their habit since these summaries commenced.

Again, there was a marked south to north time-lag between the periods of abundance of *Metridia lucens* (Figure 30). On W and X the larger numbers were taken during the first half of the year, but on T and A they were found only in the autumn. An exceptionally rich population was sampled by the X route in April which might be associated with that to the south on W in March. It was not possible to trace this northwards, however, probably because of the unusual path of the V route from June onwards and the missing records on T. It seems unlikely that the very high averages on T in September and October were associated with it; in other years about three months has appeared to be the time delay between the southern Atlantic routes and our samples in the Norwegian Sea. In common with *Calanus* and other copepods, *Metridia* was far more plentiful than usual on the A route in the summer, and it became established there earlier, in August instead of September or October.

The *Limacina* population (Figure 31) on A route in July was also quite unique in our experience. Not only was the average number about ten times as high as ever previously found, but this concentration appeared at least a month earlier than normally expected. Although *Limacina* was never abundant elsewhere during the year, its time sequence ran more or less true to form. It was first caught in May on J, W and X, and reached K by August/September. Looking at its overall distribution, one can only presume that the rich population on A arose from an indigenous stock which prospered under the unusual conditions prevailing there during 1954.

In some respects the distribution of *Clione* (Figure 32) was similar to that of *Limacina*; quite unprecedented numbers were found on A during July and August. But here again, in view of general distribution, it was probably a

¹⁾ Ann. Biol., 10, pp. 95—9.

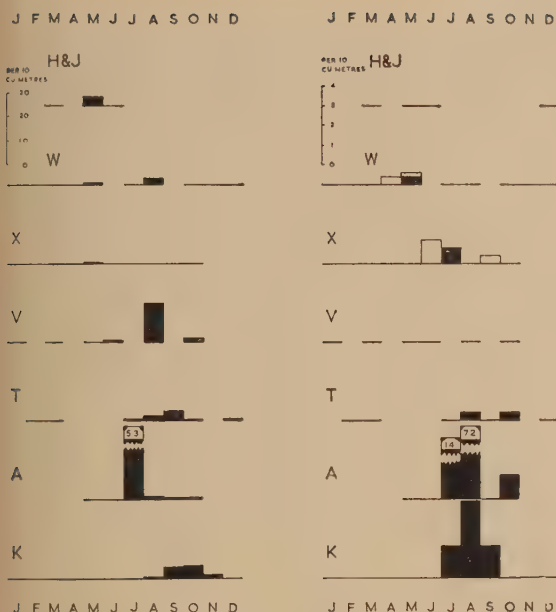


Figure 31. Histograms representing the relative numbers of *Limacina* (only those individuals larger than 1 mm. included) taken month by month from the Recorder routes H & J, W, X, T, V, A and K. Details as in Figure 26.

Figure 32. Histograms representing the relative numbers of *Clione* taken month by month on the Recorder routes H & J, W, X, V, T, A and K. Details as in Figure 26.

case of a localized development from an indigenous stock. Although not quite as high as in 1954, unusually large numbers of *Clione* were taken in this region in the late summer of 1953.

Tomopteris (Figure 33) was scarce throughout the area but showed the time succession we have come to expect. It was taken only during the first half of the year on W, X and V, and during the later half on T, A and K.

The *Thaliacea* (Figure 34) were well represented. In fact, higher numbers were caught on W in July and on X from June to August than ever before in the Recorder survey. Previously, we have considered 50 or 60 per m.³ maximal. The majority of the doliolids were *D. gegenbauri* with a few *D. nationalis*. The bulk of salps were *S. fusiformis* and it was this species which reached the T and A routes in numbers during late summer. There was, however, a second wave of salps, comprising mostly *Ihleia asymmetrica* which crossed X in August and persisted surprisingly to reach T and to penetrate into the North Sea where they were taken about latitude 58°N. on a

route not illustrated in this summary. A few *Thalia democratia* were taken at the extreme western end of the X route in July, but they could not be traced further north.

Rhincalanus nasutus was extremely scarce during the year, captures being restricted to a few specimens on J, W and X between April and June.

The outstanding feature of 1954 was, therefore, the unusual quantity of plankton found during the summer and autumn off the east coast of Scotland in the region sampled by the A route. This region does not commonly support a rich fauna when compared with most of the area covered by the survey. *Calanus*, for example, has usually been scarce on the A route when compared to the dense populations found further north on T and just to the south-east on the K route. But in 1954, there appears to have been a reversal of these conditions. *Calanus*, and other copepods, were relatively scarce everywhere except on the A route where numbers far exceeding any previously encountered in the survey were taken. This quite exceptional stock of *Calanus* persisted for several months. Also unprecedented numbers

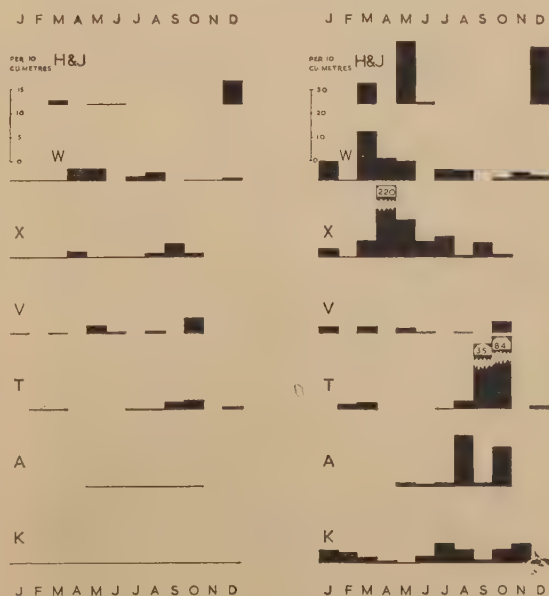


Figure 33. Histograms representing the relative numbers of *Tomopteris* taken month by month on Recorder routes H & J, W, X, V, T, A and K. Details as in Figure 26.

Figure 34. Histograms representing the relative numbers of *Thaliacea* taken month by month on Recorder routes H & J, W, X, V, T, A and K. Details as in Figure 26.

of *Clione* and *Limacina* were found on the A route in July and August. Over the years of the survey both these forms have regularly shown a time succession in their occurrence from the southern Atlantic routes northwards and into the North Sea, and for this reason their presence has been associated with the Atlantic Drift. However, in 1954 their very concentrated distribution on the A route can only be attributed to localized breeding under unusually favourable conditions.

Over the period covered by these brief annual summaries, 1948 to 1954, there has been a noticeable change in the timing of the appearance of certain "indicator species" in the Recorder catches. Their season has advanced by about two months. This can be best illustrated by reference to the W route which has remained on a fairly constant course. The position of Weather Station "J" was moved slightly to the north in March 1950, but not sufficiently to make the average displacement of the route more than a few miles. Figure 35 gives the months in which *Thaliacea*, *Clio* and *Clione* were taken on this route. It shows that in the last two years they have reached about latitude 55°N. in the Atlantic as early as April, whereas in 1948 and 1949 they did not occur there until June. The information for 1951 is inadequate, but 1950 and 1952 appear to be intermediate with first appearances in May.

A similar effect is detectable in part of the North Sea although these summaries do not demonstrate it well; the animals concerned are too scarce—or reach the North Sea in insufficient numbers—to be caught consistently in the small samples taken by the Re-

corder. However, in a more intensive programme using Hardy Indicators nightly on the herring grounds off the north-east coast of Scotland, a parallel change in the date of the first occurrence of *Clione* has been apparent. From 1948 to 1950, *Clione* was not taken in the Indicator samples before the end of August. In 1951 and 1952, they were caught in increasing numbers from about mid-August onwards, while in 1953 and 1954 they were well established on the fishing ground by early July. An equivalent shift in season, amounting to approximately two months, is therefore shown both off the south-west coast of Ireland and off the north-east coast of Scotland although some three months later in the second case. Such a three months' time lag is compatible with the expected rate of progression of the north-going Atlantic Drift; a speed averaging about 6 miles per day. Whereas the salps and doliolids are almost certainly carried in the drift and rarely, if ever, breed within the North Sea, the position regarding *Clione* and *Limacina* is less clear. They show a similar time succession from south to north as the *Thaliacea* each year and also the same variation between years. It would seem, therefore, probable that their distribution is conditioned by the Atlantic Drift in the same way as is that of the *Thaliacea*. But, in 1954, and to a lesser extent in 1953, many more *Clione* and *Limacina*—including numerous young—were found within the North Sea on the A route, than in the Atlantic. Whether these dense concentrations arise from a few exotics brought in each year by the drift or from truly local stocks remains at present a moot point, but it would appear on the evidence that their season in the North Sea at least is in some way tied to events in the Atlantic. If it is not the animals which are carried in the drift, then it is some factor conducive to their reproduction and survival which is brought into the North Sea with the water from the Atlantic.

K. M. RAE.

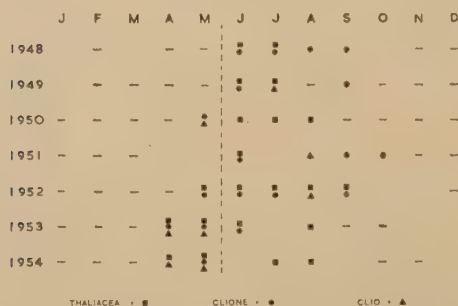


Figure 35. The months in which *Thaliacea*, *Clione* and *Clio* have occurred on the W route since 1948. A symbol represents presence regardless of numbers whereas a dash indicates that there was a valid record during the month but none of the three forms were caught.

The Dry Weight of Hensen-Net Plankton.

In 1954 the dry weight of Hensen egg-net plankton was collected from the six stations of the regular Flamborough Line of sampling positions and from eleven stations north of the Flamborough Line in June. The methods used were the same as those of former years.

The mean values for 1954 and 1953 for these two sets of stations together with comparable figures back to 1947 are given in Table 11. In the case of Flamborough Line stations the means are based on the months of June, July, and September as it is for these three months only that an annual series of comparisons can be made. For the stations of the area north of the Flamborough Line the mean refers to eleven stations in 1954 but to twelve in all other years.

It will be seen that there has been a tendency for the dry weight standing crop to rise in the Flamborough Line area over the period shown and that for the stations north of this line the years 1952—54 stand out as very markedly higher than 1947—51. The question of the cause of these changes is one of great interest and importance and it will be necessary to

Table 11. The Dry Weight of Hensen Egg-Net Plankton as mg. for m³.

	Stat. N. of	
	Flamborough Line	Flamborough Line
1947.....	55	66
1948.....	46	36
1949.....	44	47
1950.....	43	64
1951.....	43	53
1952.....	97	63
1953.....	65	81
1954.....	85	50

enquire whether less grazing or a greater phytoplankton production or perhaps a combination of both agents can have been the effective agent of this change.

R. S. WIMPENNY.

THE FISH

Eggs and Larvae.

Danish Waters.

Hauls with the 2 m. ring-trawl were carried out from S/S "Biologen" in May and June in Kattegat and the Belts, and the 1 m. ring-net was used in the Sound from M/B "Havkatten" in June.

Flatfish. Plaice larvae were completely absent from the hauls, possibly owing to the abnormal low temperature during February-March.

Flounder larvae were present in large quantities as will appear from the following:—

S. Kattegat: 29 per hour, 2 hauls, av. 1935—39: 1.8
Belts: 230 " " 9 " " 1935—39: 1.0

In both areas the number obtained is far in excess of the average for 1935—39. In later years, however, large number of flounder larvae have often been found. This applies for instance to 1950 and 1952 and in most post-war years the number exceeds the average for 1935—39.

J. KNUDSEN.

Hatching and Rearing.

The Norwegian hatching operations resulted in the liberation of 12.8 million cod larvae.

The rearing of lobster larvae was successful, more than 18,000 small lobsters were liberated.

In the laboratory, experiments were carried out with eggs and larvae of different species. In some experiments, when hatching fish eggs, antibiotics was added to the sea water. The results were positive. Feeding experiments on cod and plaice larvae proved that they were able to take food even if not fed until they were two weeks old.

Plaice larvae were this year reared at constant temperatures, and some experiments were carried out on cod larvae to study the effect of pressure on the larvae.

ALF DANNEVIG.

Plaice.

English Landings in 1953 and 1954.

During 1954 the routine sampling of the plaice landings at Lowestoft and Grimsby was continued. The main features of the landings are shown in Tables 12 and 13. The former shows the total number of fish landed by English North Sea trawlers at each port in each 5-cm. length-groups during the biological year April 1954 to March 1955, with the figures for 1953—54 for comparison.

As in previous years those length distributions have been converted into age distributions by means of an age/length key obtained from otolith samples. The age distribution of the Lowestoft landings, expressed as the number of fish caught per 100 hours fishing,

Table 12. Length Distribution of Lowestoft and Grimsby Landings.
(Thousands of fish).

Length-group (cm.)	Lowestoft 1953—54		Grimsby 1953—54		Lowestoft 1954—55		Grimsby 1954—55	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%
20—24.....	39	0.2	1	0.0	24	0.1	8	0.1
25—29.....	7,978	36.4	1,487	10.0	7,108	36.4	1,857	12.3
30—34.....	9,143	41.8	5,524	37.2	8,107	41.5	5,782	38.2
35—39.....	3,058	14.0	4,365	29.4	2,711	13.9	4,006	26.4
40—44.....	1,049	4.8	1,997	13.5	975	5.0	2,074	13.7
45—49.....	437	2.0	887	6.0	400	2.1	896	5.9
50—54.....	131	0.6	387	2.6	133	0.7	354	2.3
55—59.....	48	0.2	150	1.0	45	0.2	130	0.9
60+.....	11	0.1	39	0.3	12	0.1	42	0.2
Total.....	21,893		14,837		19,514		15,150	
Weight landed ('000 cwts.)....	133.6		136.1		122.3		139.9	
1000 hours fishing.....	280.8		349.6		255.8		304.4	

Table 13. Number of Fish of each Age caught by Lowestoft Trawlers per 100 Hours Fishing.

Age	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII+	Total
1951—52.....	91	559	2576	2055	982	261	152	71	57	60	87	6,960
1952—53.....	142	999	1424	2828	1309	519	123	106	61	40	99	7,650
1953—54.....	57	865	1920	1505	1890	773	406	129	78	53	141	7,797
1954—55.....	162	911	2394	1532	759	1041	374	209	83	43	119	7,627

with similar figures for the last 3 years, as comparison, are shown in Table 13. The three strong year-classes of 1945—1947 still form an important part of the fishery, but none of the later year-classes now in and entering the fishery appear to be of more than average strength.

J. A. GULLAND.

The German Plaice Investigations in 1954.

In 1954 the German routine investigations on the plaice stock of the German Bight were continued. As in previous years two cruises with the research vessel "Uthörn" of the "Biologische Anstalt Helgoland" were carried out, the first taking place from 27. April to 7. Maj, and the second from 25. August to 5. September. On each cruise twenty hauls of half an hour's duration with the cutter trawl were made. The data are dealt with in the same manner as in previous years. (See KOTTHAUS, 1949, 1950, 1952, 1953, 1954).

1. Age composition. (Table 14 and Figure 36).

In 1954 two waves of young fishes entered the stock, which resulted in a radical change in the age composition compared with 1953.

In spring age-group II (1952 year-class) was dominant being 77% of the catch. All older year-classes were of very little importance. In the course of the summer the 1953 year-class (age-group I) entered the German Bight

Table 14. Age Composition (%) of Plaice in the Catches from 1953 and 1954.

Age-Group:	I	II	III	IV	V	VI+	Total no. invest.
Spring 1953.....	—	23	52	14	3	8	3,678
Autumn 1953.....	37	10	32	10	3	8	2,946
Year-class:	1952	1951	1950	1949	1948	1947—	
Spring 1954.....	—	77	9	10	3	1	5,507
Autumn 1954.....	63	31	3	2	1	+	11,086
Year-class:	1953	1952	1951	1950	1949	1948—	

in great quantities, so that in autumn it was by far the greatest of all other year-classes including the 1952 year-class. Together with

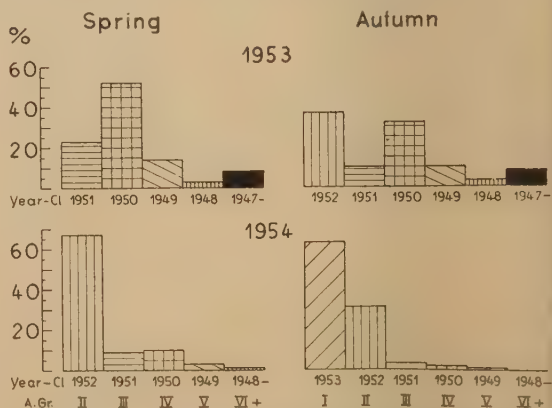


Figure 36. Percentage of the various age-groups in the catches 1953 and 1954.

Table 15. Average Length (in cm.) of the Single Age-Groups in 1948-49, 1953, and 1954.

Age-group	I	II	III	IV	V	VI	VII	Mean length of total catch
Spring 1949	—	19.5	21.0	24.3	26.5	29.8	—	23.2
Year-class	—	1947	1946	1945	1944	1943	—	—
Spring 1953	—	17.5	21.1	24.8	26.6	27.0	30.3	21.4
Year-class	—	1951	1950	1949	1948	1947	1946	—
Spring 1954	—	17.0	21.8	25.7	27.9	29.7	28.9	18.2
Year-class	—	1952	1951	1950	1949	1948	1947	—
Autumn 1948	17.9	20.6	23.2	25.7	29.4	30.1	—	22.0
Year-class	1947	1946	1945	1944	1943	1942	—	—
Autumn 1953	15.5	21.0	24.1	26.2	27.8	28.5	33.2	21.3
Year-class	1952	1951	1950	1949	1948	1947	1946	—
Autumn 1954	15.9	20.5	23.4	27.1	28.5	—	30.7	17.9
Year-class	1953	1952	1951	1950	1949	—	1947	—

the latter it formed 94% of the plaice catches in that season. The rich 1947 year-class, still found in 1953, and still with a ratio of 7%, had now almost disappeared. This remarkable renewal of the stock—not only relatively, but also absolutely—will be of great importance for commercial fishing in the following years.

2. Growth. (Table 15 and Figure 37).

The growth of plaice must be characterized as very good in 1954, for the mean lengths of each age-group were in general still higher than in 1953 and even partly higher than in autumn 1948 and spring 1949, where we noted the best growth in post-war years, as is shown in Table 15. Only the young age-groups I to III showed some decrease in their average length, probably in consequence of the intensive renewal of the stock. The fact that the 1947 year-class shows generally a reduced growth is in conformity with its extraordinary strength.

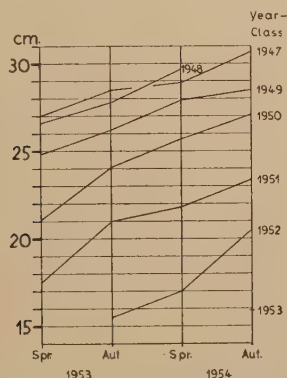


Figure 37. Average length of the various year-classes in 1953 and 1954.

3. Density of the population and relative strength of the various year-classes. (Table 16 and Figure 38).

From 1949 to 1953 the density of the plaice population decreased slowly—not wholly regul-

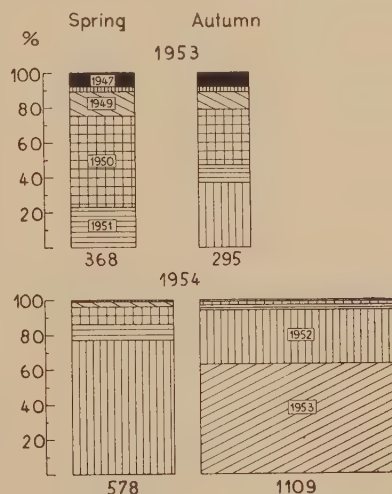


Figure 38. Percentage of the various year-classes in the catches per hour in 1953 and 1954.

arly—to nearly 1/6, as is shown by the decline of the catch per hour from 1665 fish to 295 per hour. That was mainly caused by the relatively bad broods of the years 1948 to 1951. In spring 1954 the catch per hour rose to 578 as a result of the rich 1952-class entering the stock. This increase continued and 1,110 individuals per hour were reached in autumn 1954, which was caused by a second wave of young fish (1953 year-class). From 1953 to

Table 16. Catch per Hour of the Various Age-Groups in 1953 and 1954.

Age-group	I	II	III	IV	V	VI+	Mean catch per hour
Spring 1953	—	84	192	51	12	29	368
Autumn 1953	110	30	94	28	8	25	295
Year-class:	1952	1951	1950	1949	1948	1947	
Spring 1954	—	449	52	55	15	7	578
Autumn 1954	699	344	30	24	5	7	1,109
Year-class:	1953	1952	1951	1950	1949	1948	

Table 17. Percentage Ratio of Plaice of more than 25 cm. Length in the Catches from 1953 and 1954.

Age-group	I	II	III	IV	V	VI	VII	VIII	Total %
Spring 1953.....	0	0	4	44	72	79	96	100	16.6
Autumn 1953....	0	4	34	70	80	90	100	—	27.2
Year-class.....	1952	1951	1950	1949	1948	1947	1946	1945—	—
Spring 1954.....	0	—	11	64	84	89	89	100	10.9
Autumn 1954....	0	3	32	79	85	100	100	100	4.3
Year-class.....	1953	1952	1951	1950	1949	1948	1947	1946—	—

1954 all year-classes above 1951 have lost numbers, so that to-day they are no longer of any importance in the German Bight.

In the previous reports an attempt was made to determine the relative strengths of the various year-classes by comparing their contribution to the catch per unit during the third and fourth year of life. Continuing in this way we now may establish the following range for the year-classes 1946 to 1951:—

Year-class	1946	1947	1948	1949	1950	1951
	22	100	28	43	41	9

At present we may not judge definitively the relative strength of the 1952 and 1953 year-classes, but we may say that they are richer than the previous ones, especially the 1953 brood. Tentatively the 1952 year-class may be given an index of nearly 70, and if we consider that the 1953 year-class in 1954, as I-group, was already present with 700 individuals in a catch per hour of 1,110 and that these small fishes are not caught in proportion to their

actual numbers, we may conclude that it is still much richer than the 1952 year-class, and may prove to equal the strong year-class of 1947. The abnormal strength of these two youngest year-classes corresponds with a very heavy spawning in the area NW. of Helgoland (from White Bank to Clay Deep) observed in 1952 and 1953.

4. Length distribution. (Table 17 and Figure 39).

Generally speaking the plaice in 1954 were almost 3 cm. smaller than in 1953. This results from the strong recruitment to the stock and the very pronounced decline of the older year-classes. In consequence of this the ratio of marketable fish in the catches has gone down considerably from 27.2% in the autumn of 1953 to 10.9% in spring and only 4.3% in the autumn of 1954. The slow growth of the rich year-class is demonstrated by the fact that slow-growers only passed the 25 cm. limit after their eighth year of life.

A. KOTTIAUS.

Food Investigations on Plaice.

277 plaice were investigated for stomach contents in spring 1954, and 325 in autumn, from 20 stations of the cruises.

As shown by the sampler catches, the stock of bottom invertebrates, chiefly of first-class plaice food species, is found reflected in the composition of the food taken by the plaice. In general terms the plaice mainly takes lamellibranchs in spring, while in autumn polychaetes are more frequently taken. A larger percentage of the plaice investigated in spring had taken lamellibranchs, while in autumn the percentage of the plaice which had taken polychaetes was larger. This is shown in Table 18.

Only in 1954 was the percentage of plaice containing worms higher in spring as well as in autumn than that of plaice containing shellfish. This is easily understood from the change in the stock of invertebrates described below.

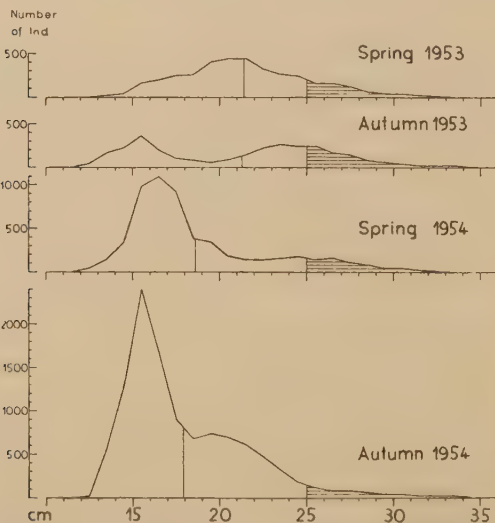


Figure 39. Length distribution of the total catches in 1953 and 1954 (shaded: the marketable ratio).

Table 18. Stomach Contents of Plaice.

	1950		1951		1952		1953		1954	
No. of plaice investigated....	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn
% containing lamellibr....	109	214	132	211	253	273	314	299	277	325
% containing polychaetes....	74	62	90	81	92	69	88	52	76	36
	62	71	86	88	76	91	77	78	83	89

Worms occurring in dense patches, such as *Lanice conchilega* and *Pectinaria* (chiefly *P. koreni*) were most frequently eaten by the plaice. In the autumn of 1954, 63% of the plaice investigated contained *Lanice*, and 51% *Pectinaria*. In a comparatively large number of plaice the stomach content was exclusively formed by *Lanice* and *Pectinaria*. This tends to show that the plaice do not feed indiscriminately, but make some choice.

E. ZIEGELMEIER.

Investigations of the Bottom Fauna.

Investigations of the bottom fauna, combined with investigations on the stomach content of plaice, were continued in the eastern part of the German Bight, at 21 stations in spring and autumn of 1954 (101 samples).

In 1953 the abundance of lamellibranchs and chaetopods (first-class plaice food) about equalled that of the preceding years. In 1954 the abundance of lamellibranchs decreased very greatly, averaging 17.3 specimen per 0.1 square metres in the area of investigation. This is a minimum never reached since the start of the investigations in the autumn of 1949. The stock of *Angulus fabula*, the species which is most common and much eaten by plaice in the inshore parts of the German Bight, decreased very much.

Only a small increase to 25.5 specimens per 0.1 m.² was found in autumn 1954. At this time, *Abra alba* and *A. nitida*, mostly young specimens, were found in somewhat larger numbers at stations with muddy soil. These species are first-class plaice food too.

The polychaetes, on the other hand, were

about of equal abundance as the lamellibranchs in spring (1954) (14.7 per 0.1 m.²). In autumn they gained the highest maximum since 1949 (91.8 per 0.1 m.²). *Pectinaria koreni*, *Lanice conchilega*, *Spiophanes bombyx*, and where there was fine to moderately coarse sand, *Magelona papillicornis*, *Spio filicornis* and *Goniada bobretzkii* were chiefly represented. The large number of very young polychaetes was a very striking feature. An increased weight of the stock might be forecasted for 1955.

The abundance of crustacea (mainly amphipods) and echinoderms (*Echinocardium cordatum*, *Ophiura albida* and *O. texturata*) was almost equal to that of 1953.

Hydrobia ulvae is only found in numbers on soft bottom off the Elbe estuary. Its abundance was similar to that of 1953. With the exception of *Lunatia nitida* other species of gastropods are rarely found in the grab. *Lunatia nitida* is of considerable importance because it feeds on lamellibranchs. In 1949 and 1950 the species was only occasionally found in the bottom samples at the deep stations near Helgoland. After the rise in the abundance of lamellibranchs in the autumn of 1950 the abundance of *Lunatia* increased too. From autumn 1951 the species could be found at almost all stations. It was fairly abundant and frequent until 1953, but in 1954 after the decrease of the lamellibranchs, the stock decreased very much, and in autumn 1954 only a few small *Lunatia* were found at the Helgoland stations. Also the number of shells with freshly bored holes was less than in previous years.

E. ZIEGELMEIER.

Table 19. Length Composition of Plaice over 27 cm. Length in Danish Catches in 1953 and 1954 (‰).

Area.....	B4, 20—30 m.		C2, NE.		Dogger	
	1953		1954		1954	
	June-Oct.	May-Nov.	June-Aug.	Aug.-Nov.	May-Aug.	June-Nov.
Months.....	3	21	12	6	11	6
No. of catches.....						
cm. group						
27—30.....	871	793	513	668	199	290
31—35.....	118	199	360	297	309	446
36—40.....	11	7	83	28	258	180
41—45.....	0	1	18	4	132	66
46—50.....	0	0.2	15	2	76	9
51.....	0	0	11	1	26	9

The Danish Plaice Fishery in the North Sea.

Density of the stock.

The mean weight in tons of plaice caught per fishing trip for landing on the market at Esbjerg were as follows (number of landings in brackets, map of areas in Ann. Biol., 4, p. 101):—

	1951	1952	1953	1954
A3N, 3N				
May-June...	2.8 (5)	3.1 (5)	—	4.8 (8)
B4 May-Nov....	—	5.5 (6)	4.7 (3)	3.2 (31)
C2,NE.				
June-Oct....	5.2 (10)	6.2 (18)	4.3 (11)	5.9 (7)
C2,NW. Aug....	—	6.0 (4)	6.4 (9)	6.3 (3)
Dogger May-Nov.	3.3 (9)	3.3 (14)	4.2 (12)	3.1 (6)

At depths between 20 and 40 m. off the Jutland coast the stock of commercial fish has obviously been less dense during recent years.

At depths of 10—20 m. off the Jutland coast the density has increased corresponding to the recruitment to the stock from the rich 1950 year-class. The poorness of the preceding year-classes is reflected by the decrease in catches landed from the grounds between 20 and 40 m. off the Jutland coast, B4. The decrease in landings from the deeper grounds, C2,NE. and C2, NW. between the Horns Reef and the Dogger Bank seems to be due to less fishing for plaice in this region on account of the increasing fishery for herring. The landings from the Dogger Bank have diminished no doubt on account of the disappearance of the rich 1947 year-class and the poorness of the following year-classes.

Length-composition of the stock.

At the grounds off Jutland in 20—30 m. depth the length composition of the landings had shifted towards larger size-groups because the recruitment to the stock by small fish has been poor (Table 19). At the Bløden Ground, C2, NE., the relative and the actual numbers of the smallest commercial plaice had increased whereas the relative number of plaice of 31—35 cm. length and larger had decreased. Consequently the stock must have been recruited by small fish, and we must suppose that they have arrived here from the south or south-west, because the good 1950 year-class on the Danish grounds does not seem to have reached so far out.

AA. J. C. JENSEN.

The Stock of Plaice off Esbjerg.

Trawling in the southern Horns Reef area was carried out from M/C "Jens Væver" on

$30/6$ to $3/7$ 1954. A 50 ft. otter-trawl with 9 mm. mesh in the cod-end was used. 20 hauls of 30 minutes, and 3 of 60 minutes duration were made. The number of plaice caught at depths beyond 10 metres was considerably below that which has usually been obtained in the period May-August (cf. JENSEN, Ann. Biol. 10:111). The numbers per hour were:—

	5—9 m.	10—29 m.
1934—39...	—	374
1950.....	230	464
1951.....	929	215
1953.....	603	347
1954.....	314	42

The results of age determinations (also for previous years, from JENSEN, l.c.) are shown in Table 20. The 1951 and 1952 year-classes are particularly weak in the present material. The former was weak in the Waddensea, too, in 1951 and 1952 (Ann. Biol., 8:111; 9:132), and in the Horns Reef area in 1953 (Ann. Biol., 10:111). The 1952 year-class, however, was fairly rich in the Waddensea in 1952 and 1953 and in the Horns Reef area in 1953.

Table 20. Age Distribution of Plaice from the Southern Horns Reef Area in June-July 1954, and in May-August of previous Years.

	Age-group	I	II	III	IV	V+
Depth 5—9 m.	{ 1950....	69	83	89	2	—
	{ 1951....	216	419	135	168	7
	{ 1953....	432	77	89	5	0.3
	{ 1954....	256	58	0.3	—	—
Depth 10—29 m.	{ 1934—39	132	150	53	14	27
	{ 1950....	25	109	284	45	2
	{ 1951....	11	79	56	62	9
	{ 1953....	199	40	87	14	6
	{ 1954....	27	17	1	2	4

ERIK URSIN.

Young Plaice in the Danish Waddensea 1954.

Investigations with the modified Petersen young-fish-trawl were carried out as usual in late June, late August, and late October. A total of 127 hauls of 15 minutes duration is available.

A considerable number of 0-group plaice was found in the northern area (Ho Bay—Knude Deep) in which 80 hauls were made. The number per hour was 475 against a mean of 215 for the years 1935—54. The I-group was weaker: 153 per hour against a mean of 172. This year-class (1953) was below average as 0-group (Ann. Biol., 10:43). The number

of young plaice in the southern part of the Danish Waddensea (Juvre Deep—Højer Flak, 47 hauls) was smaller: 77 0-group and 37 I-group per hour. The corresponding numbers for 1953 (46 hauls) are 70 and 47.

ERIK URSIN.

Flatfish in the Skagerak-Kattegat Area.

1. Coastal investigations, 0- and I-group.

The number of 0-group plaice caught per hour with a Johansen young-plaice-trawl was very much below normal as was the case also in 1953. In 1952 the number of 0-group plaice in the northern Kattegat was a little below normal but in the central Kattegat it was rich. In 1951 and 1950 the number of the 0-group was abundant in the northern Kattegat but in the central Kattegat it was below the mean in 1951 and poor in 1950. In the northern Kattegat the number of 0-group plaice was about the mean in 1953 but below the mean in the preceding years.

The number of 0-group flounder is normally 1 or less per hour in the Skagerak and at the Danish coasts of Kattegat; it is seen that the number was very much above the normal in the central Kattegat but in the Laholms Bay where the average is 104 per hour the number was very much below this.

As is most frequently the case, the number of young turbot caught on these coasts was very small.

Table 21. Number of Plaice and Flounder caught per Hour.

In brackets: Mean for 1905—54 on the Danish, for 1929—38 on the Swedish coasts.

	No. of stations	Plaice		Flounder
		0-group	I-group	0-group
Skagerak	3	9 (81)	2 (16)	0
N. Kattegat	10	22 (80)	8 (52)	0
C. Kattegat	13	4 (39)	0.5 (12)	13
S. Kattegat, Danish	5	2 (16)	0.4 (2)	1
— Swedish	7	7 (192)	0 (2)	9

2. The stock of plaice in the Kattegat.

The age of the plaice caught in the Danish quantitative trawling in the northern Kattegat has only been determined as yet at a few of the stations. Therefore the total number has been shown in Table 22. The age-group figures for the fish from the central and southern Kattegat are preliminary. It is seen that most of the plaice originated from the 1951 and 1952 year-classes of which the 1952 year-class was

Table 22. Number of Plaice caught per Hour with Trawl.

A single haul with eel-tog has been added after multiplication of the catch by 3. In brackets number of stations.

	Mean for		
	1927—39	1953	1954
Northern Kattegat			
5—14 m.	1105	342 (2)	36 (1)
15—24 -	728	77 (10)	51 (4)
25—34 -	125	44 (6)	33 (3)
> 35 -	6	5 (8)	16 (6)
Central and southern Kattegat			
5—14 m.	212	117 (7)	4 (1)
15—24 -	6	4 (10)	0 (2)
25—34 -	—	7 (12)	7 (8)
Age-groups ¹⁾	II	III	IV
Year-classes	1952	1951	1950
5—14 m.	4	—	—
15—34 -	2	4	1

¹⁾ Preliminary figures. No 0- and I-group.

abundant on the coasts of the central Kattegat in 1952. In 1951 the number of 0-group plaice was below normal in the central Kattegat but above normal in the northern Kattegat and the proportionately greater numbers of the III-group found in 1954 in the central and southern Kattegat must be due to an immigration from the northern Kattegat. This has also been suggested from marking experiments.

The number of hauls at depths of less than 25 m. is too small to allow for an estimate of the density of the stock of I-group and older plaice, but it appears that the total stock in the northern Kattegat has been very much less than the average before the war. However, the average numbers of 0-group found on the coasts has decreased very little when compared with the years before the war, and it has not been possible to find a definite explanation for the decrease in the numbers of I-group and older plaice. It is not reasonable to think it due to the fishery for processing because very small amounts of plaice were found in these catches when analysed, and the implements used in this fishery very seldom take plaice. The fishermen of course sort the undersized plaice from the catch immediately after catching them, but if considerable quantities are taken it is in practice impossible to find all of them and some must be found by analysing the fish landed. Fishing from research vessels with the trawls used in the fishery for processing has moreover confirmed that small quantities only

of undersized plaice (and of plaice over the size limit) are caught in this fishery. The fact that the pound-nets are every year extended into greater depths and now also are placed at the northern side of the Scaw on the Skagerak coast is possibly a hindrance to the young plaice migrating from the Skagerak into the Kattegat. Normally a very great part of the I-group in the northern Kattegat originate from the Skagerak coast and the migration takes place along the coast. It is also well known that older plaice will accumulate along the leader of the pound-nets because they are scared of passing through them even if they are only "funkis" leaders with vertical ropes at a distance of about 20 cm. apart.

AA. J. C. JENSEN.

3. The Limfjord stock of plaice.

Investigations were carried out by means of the eel-tog in June and September. The numbers caught per hour are shown below, the means for the period 1927—52 are given in brackets.

	Nisum Broad
June.....	106 (658)
September...	229 (918)

Until now the investigations in the Nisum Broad have only been carried out at a small number of stations (4—8). As the stock of plaice in this area is very irregularly distributed the standard deviation for the mean becomes very high, only very pronounced fluctuations can be demonstrated. The fluctuations observed will certainly not reflect the fluctuations in the actual stock.

The age composition of the stock in the Nisum Broad was as follows (catch per hour):—

Age-group	Year-class	March	June	September
I.....	1954	0	0 (0)	47 (66)
I.....	1953	6	68 (154)	150 (380)
II.....	1952	20	38 (294)	31 (346)
III.....	1951	2	0 (176)	0 (112)
IV.....	1950	0	0 (36)	0 (22)

In most years the II-group dominated the catches in all three months. A migration of I-group plaice from the North Sea to the Nisum Broad seems to have taken place from March to September, because this group dominates the catches in June and September. The III-group and older fish are not represented at all in these two months.

O. BAGGE.

4. Transplantation of plaice to the Limfjord.

It was intended to transplant 328,000 kg. to the Limfjord (224,000 kg. to Thisted Broad and 104,000 kg. to Løgstør-Hannæs Broad), but due to unfavourable conditions (cf. p. 81, Transpl. of plaice) only 133,765 kg. or 1,871,000 specimens were liberated. Of these 75,620 kg. were liberated in Thisted Broad and 58,145 kg. in Løgstør-Hannæs Broad. Like the Belt Sea transplantation (p. 81) all the plaice were transported in well-smacks. At the beginning of the transplantation at first in April the temperature of the water was 2.5 to 4°, during the month it rose to about 8° and was 11—12° when the work was stopped the 12. May. 1,265 plaice were examined for length and weight. This year the mean length was 19.5 cm. and the mean weight 71 g., this is somewhat below the normal in contrast to 1953 when the plaice were unusually large (22.1 cm. and 110 g. on average).

Age analysis of 854 specimens gave the following result: II-group: 85%, mean length 18.5 cm.; III-group: 14%, mean length 23.0 cm. In 1953 the composition was 85% III-group and 14% II-group.

The experiments with tattooed and subcutaneously tagged plaice carried out in 1953 (cf. Ann. Biol., 10, p. 126) showed that the results of marking with Petersen discs were biased due to the fact that plaice tagged in this way were caught more effectively by the nets than untagged. As expected the tattooing disappeared gradually with the result that in the last part of the fishing season the recapture percentage of these fish was too low compared with the actual catch.

To replace the Petersen discs in these experiments a new tag was constructed and tried in the 1954 experiment. It consists of a plastic label with a printed number and instruction to the finder and rolled in a cylinder with pointed ends. It is attached with a nylon string through the base of the dorsal fin and anchored in a plastic strip under the skin of the blind side. In Thisted Broad a total of 600 plaice were tagged in this way together with 300 tattooed and subcutaneously tagged and 300 with Petersen discs. At 1. August, before any significant bleaching of the tattooing appeared, the percentage of recaptured undersized fish was: 24% tattooed, 25% with roll-tags and 56% with Petersen discs. This indicates that plaice with roll-tags similar to the tattooed fish, but in contrast to those with

discs, are not caught more easily by the nets than untagged. Consequently the returns of roll-tags could be used for the calculation of the result of the transplantation. According to this calculation the transplantation to Thisted Broad yielded about 40 tons. According to the fishery statistics only 21 tons were caught but it is known that quite a large percentage of the yield of this small fishery is not reported. The calculated recapture percentage by weight was about 55%. According to the difference in price between the transplanted small fish and the landed marketable fish a catch of 31 tons would have paid for the transplantation. Although the transplantation has been profitable, the mortality of the plaice is very high. According to the calculation only about 15% of the fish have been recaptured.

O. BAGGE, E. BERTELSEN.

Dab.

1. Dab in the German Bight.

During the cruises of the research vessel "Uthörn" from August until November 1954 in the area between Otzumer Balje and White Bank 31 hauls were carried out with the cutter trawl with sole cod-end and 9 hauls with the Helgoland trawl.

6955 otoliths of the common dab were examined in order to determine the age composition of the stock. The percentage age composition is given below. The numbers in brackets represent the number of dabs investigated.

Age-group	Helgoland trawl	Cutter trawl with sole cod-end
0.....	2.5 (36)	— (—)
I.....	24.0 (344)	0.4 (22)
II.....	26.8 (384)	5.8 (320)
III.....	21.8 (313)	21.4 (1181)
IV.....	13.5 (193)	31.8 (1756)
V.....	6.9 (99)	19.8 (1094)
VI.....	3.1 (44)	13.4 (737)
VII.....	1.3 (19)	6.8 (376)
VIII.....	0.1 (1)	0.5 (30)
IX.....	— (—)	0.1 (5)
X.....	— (—)	+ (1)
	100.0%(1433)	100.0%(5522)

The growth rate of the dab is very low. The following table shows the average length in cm. of the age-groups:—

Age-group	Females	Males	Total
0.....	—	—	4.7
I.....	12.4	12.1	12.3
II.....	16.2	15.2	15.7
III.....	18.2	17.0	17.6
IV.....	19.8	18.0	18.9
V.....	21.4	19.0	20.2
VI.....	22.6	19.8	21.2
VII.....	23.6	20.5	22.1

HJ. BOHL.

2. Dab in the Kattegat.

The number of dabs caught per hour's haul with the cod trawl are shown in the following summary:—

	No. hauls	1954	1953	Average 1951—54
N. Kattegat.....	14	184	271	213
C. Kattegat.....	1	38	45	59
S. Kattegat.....	8	175	348	224

It will appear that the quantity obtained in 1954 is somewhat smaller than that of the previous year and also than the average of the period 1951—54. The stock consisted mainly of young fish, the I- and II-group forming by far the majority of the catches.

J. P. JENSEN.

3. The Limfjord stock of dab.

Quantitative fishing in the Limfjord showed an increase in the stock of dab in the Nissum Broad compared with 1953 but the stock was still considerably below the mean for 1927—52. The numbers per hour's haul with the eel-tog were as follows:—

	Nissum Broad		
	1954	1953	1927—52
June....	18	6.2	78
September	33	2.8	188

In the inner part of the Limfjord there were no dabs in June and very few in September.

O. BAGGE.

Eel.

Prediction of the Yield in the Limfjord.

A yield of the silver-eel fishery of ca. 5% below the normal was predicted from the summer temperature for the Limfjord. According to the fishery statistics it would seem that the total catch of silver-eel was much larger than was normal for the years since 1940, although it was only about half of the amount of earlier years. Actually we cannot compare

the catch this year with that of previous years because the collection of the statistics has been rearranged and has been drawn from other sources than previously, and the discrimination between what is called silver-eels or yellow eels may be rather subjective. For the Belt Sea the rearrangement of the collection of fishery statistics does not seem to have given noticeable changes for the division between yellow and silver-eels, the yield corresponded to the prediction (cp. p. 00).

AA. J. C. JENSEN.

Fish for Industrial Processing.

The Danish landings from the North Sea, the Skagerak, the Kattegat and the Limfjord of fish sold to the fish-meal factories, ensilage, fish-ponds and fox-farms increased by 19% when compared with 1953 to 190 mill. kg., but of this quantity 60% was herring of various sizes although mostly small herrings.

The remainder was mainly the by-catch from the special herring fishery for processing carried out with the small-meshed trawls. However, it also includes the catch of fish other than herring which were sold for processing from the fisheries for fish for consumption, especially from the fishery for the deep-sea prawn and the pound-net fishery. It also includes the fish for human consumption condemned for this use on account of bad condition, and fish for human consumption which must be sold as fish for processing when the market is overfilled. In 1954 only small quantities of fish for consumption were sold in this manner as compared with some of the preceding years.

In 1954 a large number of samples from the landings at the main ports were examined by the Fishery Control. On the basis of this control and the analyses at the laboratory the composition of the landings was calculated (Table 23).

The fishery for sand eels at Vyl ground off Esbjerg yielded 10.8 mill. kg. including practically no other species. The remaining part of the about 20 mill. kg. of other species landed for processing from the North Sea are the by-catches from the herring fishery and consists mainly of whiting (about 7 mill. kg.). After the first April whiting of less than 20 mm. length constituted on an average less than 1% of the landings.

From Skagerak and northern Kattegat 29

Table 23. Catch (in tons) of Fish for Industrial Processing in the Near Northern Seas Area.

	1952	1953	1954	
			Herring	Other species
North Sea.....	32,859	58,190	58,018	19,995
Skagerak.....	65,948	78,108	38,215	37,091
Kattegat.....	22,528	20,610	16,298	17,101
Limfjord.....	3,847	3,344	2,383	1,589
Ringkøbing and Nissum Fjord .	19	8	0	18

samples from the fishery for processing were analysed (cp. Table 24). 10 of these were taken before the prohibition of landing catches with more than 10% whiting under 20 cm. length was put into force. In one of these there was 47% undersized whiting but the average for the landings was as low as 6.8%. After the enforcement of the London Convention the 19 samples investigated contained on an average only 2.1% undersized whiting. The amount of small whiting found in the sea was in 1954 not so large as normally, and the fishermen could mostly avoid the grounds where the small whittings were present.

When we compare the percentages of the other fish species with those of the previous years we must take into account that the figures found in 1954 must be reduced by ca. 10—20% on account of the less numbers of whiting. It is obvious that the percentage of herring was about the same as in 1953 but higher than in 1952 and that the percentage of sprat was higher than in both of these years.

Of the food fishes other than whiting, herring and sprat, the long rough dab constituted in the spring months two thirds, and in the rest of the year the poutassou and long rough

Table 24. Proportion of Species in Landings of Fish for Industrial Processing from the Skagerak-Kattegat, and the Limfjord. (In % by weight).

	Skagerak-Northern Kattegat Trawls		Hals-Djursland Pound-nets	Limfjord Trawls
Gear.....	Jan.-March	June-Dec.	July-Aug.	mm.
Mesh, cod-end.....	11—14 mm.		—	11—14
Months.....	Jan.-March	June-Dec.	July-Aug.	mm.
No. of samples	10	19	11	3
% fish for processing	930	941	624	968
Whiting under 20 cm.	68	21	—	—
— over —	81	41	—	—
Herring.....	465	470	531	450
Sprat.....	323	315	428	545
Other food fishes.....	32	45	—	—
Non-food fishes.....	31	107	41	2
Invertebrates.....	1	1	—	2
Total . . .	1001	1000	1000	999

dab constituted the majority. Of undersized and commercial cod and haddock together, there was less than 1% in the catches. Other fishes gave only 3—11% of the catch, Norway pout and poor cod constituted the major part of these.

From the deep-sea prawn fishery 2 samples were analysed. Also in these small whiting were few. In a winter catch when the fishing is carried on in comparatively shallow depths about half of the fish for processing was herring, a third was large whiting. In a summer catch the three fourths was poutassou and 14% were silver smelt. One landing from the pound-nets was analysed where the fish for processing made out 67% of the total catch. The fish for processing was mostly horse mackerel, but this naturally is not typical for the total landings of fish for processing from this fishery.

From pound-nets between Hals at the entrance to the Limfjord and Djursland (the Aalborg Bay) 11 samples were analysed. This fish for processing was almost exclusively small herring and sprat with whiting, and the same was the case with 3 analyses of other seine catches from the Limfjord.

AA. J. C. JENSEN.

Rare Fishes.

Scotland.

The following rare fishes were landed in Scotland from the North Sea and western grounds in 1954.

Cetophorus squamosus (GMELIN)—20: Butt of Lewis to Flannan Isles, IV.

Squatina squatina (L.)—3: 24' ESE. Aberdeen, IV; W. Shetland, VII; Moray Firth, IX.

Torpedo nobiliana, BONAPARTE—4: 70' N. Rattray, I; 10' SE. Bell Rock, VI; Sulisker, IX; 23' NW. × W. Noup Hd., XI.

Trygon pastinaca (L.)—2: 50' N. Rattray, I; Bell Rock, X.

Chimaera monstrosa, L.—1: 20' NE. × E. Eyemouth, IV.

Acipenser sturio, L.—13: Johnshaven, I; Moray Firth, II; North Coast, II; 40' N. 1/2 E. Buchan Ness, III; 45' S. × E. Aber-

deen, III; 22' NE. × E. Eyemouth, IV; Cruden Bay, V; Firth of Clyde, V; Loch Eriboll, V; Sule Skerry, VI; Turbot Bk., VI; 8' NE. Rattray, VI; 65' S. × E. Aberdeen, IX.

Alosa alosa (L.)—1: N. Minch, XI.

Alosa finta (CUVIER)—7: Firth of Clyde, III; Scottish east coast (4 specimens), III; N. Minch, IV; 50' S. × E. Aberdeen, X.

Sardina pilchardus (WALBAUM)—2: Johnshaven, I; North Minch, IX.

Belone belone (L.)—3: NE. North Sea, V; Berwickshire Coast, V; SE. of Wick, XI.

Lampris guttatus (BRÜNNICH)—1: Shetland, XII.

Trachypterus arcticus (BRÜNNICH)—15: Shetland (3 records), I; 110' NE. 3/4 E. Buchan Ness, I; Orkney (2 records), I; Lousy Bank, III; S. Shore Moray Firth (3 records), III; Kincardineshire coast, V; Aberdeenshire coast and neighbouring banks (4 records), VI.

Capros aper (L.)—four specimens Porcupine Bk., VIII.

Brama raii (BLOCH)—4: Flugga, IX; Butt of Lewis, IX; Flugga, X; Gardenstown (Moray Firth), XII.

Mullus surmuletus, L.—13: Scottish east coast I, II, III, IV, V (2 records) VI, IX (4 records), X; Flannan Isles, V.

Spondyliosoma cantharus (GMELIN)—5: Scottish east coast I, III, VI, IX, XI.

Mugil capito, CUVIER—1: Mouth of River Dee, Aberdeen, VI.

Mola mola (L.)—1: off Fraserburgh, X.

These records together with those of rare indigenous species, will be dealt with in greater detail in a paper to be published in the *Scottish Naturalist*.

B. B. RAE, E. WILSON.

Germany.

Myliobatis aquila L. 1758, female of 90 cm. total length, caught by the steam trawler "Imsum" in the Channel and delivered to A. KOTTHAUS on 18. January 1954.

Baltic-Belt Seas.

INTRODUCTION

Contributions have been received from O. BAGGE, E. BERTELSEN, G. DIETRICH, G. GRANQVIST, AA. J. C. JENSEN, I. BOHUS JENSEN, J. P. JENSEN, J. KNUDSEN, F. KOCZY, R. KÄNDLER, V. SJÖBLÖM, and H. THOMSEN.

The hydrographical investigations are the subject of about half of the contributions to this report. It is quite natural that they occupy so much space here because the differences in the hydrography of the various parts of the area and their great fluctuations in time, directly or through other environmental factors, effect the fish stocks. Important investigations on the fish stocks in the area are reviewed in other parts of the *Annales Biologiques* under the Gadoid Fish, Herring, and Scombriform Fish Committees.

A. Environment.

The main features of the hydrography were, firstly, the two cold months February and March when easterly winds dominated, and secondly the dominant westerly winds during most of the rest of the year, and which were very strong at times.

The increase in salinity in the Belts and southern parts of the Baltic, which has followed the climatic change, was especially pronounced in 1954. The mean salinity was very much higher than normal in the lower layer at Kattegat SW. lightvessel (Schultz's Grund) in June-September, and at Gedser in April-September. At Halsskov Rev lightvessel

in the Great Belt the salinity was mostly above normal both at surface and bottom. At Drogden the surface salinity shows that inflow from the Kattegat took place in January, March, April, June, July, September, and December. At Oskarsgrundet lightvessel the inflows were felt at 8-metre depth in June-July and September-November, and GRANQVIST has shown in Table 8 that the salinity in 1954 was very much higher in the northern half of the Baltic than from 1903 to 1939. Especially strong inflows of saline water occurred in March, through the Great Belt, and in June-September. More or less simultaneously with these inflows high-saline water came into the Baltic proper through the Sound and reached the Oskarsgrundet lightvessel in March, June-July, and September-November.

As a consequence of these inflows the bottom water at Bornholm was renewed. THOMSEN ascribes the renewals partly to vertical mixing due to the cold winter. The oxygen content at Christiansø, NE. of Bornholm, increased during the last part of March. In the deeper layers in this region it is often found that very different water bodies occur at the same depth and may replace each other, and at Christiansø old water with low salinity was found again almost unmixed during May-August. However, bottom water with a high oxygen content was found on 1. July a little more to the south-east (KÄNDLER). Bottom water with low oxygen content was found also in the central Baltic (Koczy).

B. The Fish.

Eggs. KÄNDLER reports that there were very few plaice eggs at the Fehmarnbelt lightvessel but those of flounder and dab and cod were normally represented. In the Danish straminet hauls the larvae of plaice were very few and those of flounder frequent. Eggs of sprat were few at Fehmarnbelt. In the middle of June KÄNDLER found many mackerel eggs in the Great Belt and the adjacent parts of the western Baltic. In the Bornholm basin proportionately great numbers of cod eggs were found by KÄNDLER in July together with sprat eggs.

Plaice. The 0-group of plaice were few in numbers in the Danish coastal investigations.

The numbers of plaice per trawl hour in the Belt Sea, investigated from the "Biologen", were considerably greater than usual but only about a tenth of that in 1953.

In the Sound ordinary trawl fishing is prohibited and here proportionately many more old and large plaice were found. In the westernmost part of the Baltic proper the plaice were a little more numerous than in previous years but more to the east they were as scarce as usual.

The weight of plaice in the transplantations to the Belt Sea was 37% greater than in 1952, or almost 100 tons, but the number was 132% greater. The recovery of the marked transplanted plaice was very low in the Belt Sea,

and BAGGE and BERTELSEN draw the conclusion that the transplantation method must be improved.

Dab. The stock of dab was relatively great in some parts of the area but relatively small in other parts.

Flounder. The numbers of 0-group fish found in the coastal investigations was about normal in the Belt Sea but below normal in the Baltic proper. The density of the stock caught in the trawl by "Biologen" was below the normal corresponding to the poor, or rather poor, year-classes from recent years.

Eel. As usual a forecast for the catch was published and as is most often the case, it was justified.

Fish for Industrial Processing were caught in smaller quantities than in the two previous years which seems to be due partly to a comparative scarceness of herring of sufficient size in these waters in the summer months, when the landing of the smallest ones are prohibited, and partly to comparatively smaller amounts being sold for processing from sources other than the small-meshed trawls.

Salmon. The German salmon catch rose in 1954/55 to almost double that of 1950/51. The salmon which had spent 2 and 3 years in the sea dominated both the Danish and the German catches.

AAGE J. C. JENSEN.

ENVIRONMENT

Hydrography.

Table 1. Monthly Means of Salinity and Temperature at Surface and Bottom at the Light-vessel "Halsskov Rev" for a Series of Years, and Deviations from these Means.

(From the Danish Meteorological Institute, Nautical Department)

Month.....	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity					Surface							
Mean.....	16.8	14.8	13.4	13.9	13.0	14.3	13.9	14.4	14.6	16.2	16.3	15.6
Deviation 1954.....	3.1	—	—	4.1	-1.1	—	4.4	-0.8	3.1	2.3	0.3	1.7
					Bottom							
Mean.....	31.9	31.7	24.5	27.6	29.7	30.3	29.4	27.6	24.7	23.3	21.5	22.1
Deviation 1954.....	-0.2	—	—	0.5	-1.5	—	2.5	2.1	3.7	-0.8	-1.7	0.2
Temperature					Surface							
Mean.....	2.4	2.0	2.4	4.5	8.9	12.7	15.7	16.4	14.5	11.1	7.3	4.0
Deviation 1954.....	0.5	—	—	0.1	0.9	—	-0.8	-1.4	-0.3	-0.4	0.2	0.8
					Bottom							
Mean.....	3.9	3.4	3.4	4.3	5.7	7.1	9.1	11.7	13.2	11.6	8.4	5.9
Deviation 1954.....	-0.3	—	—	1.1	0.2	—	-2.0	-1.8	-0.8	-0.4	-0.1	-0.1

Danish Observations in the Belts.

The general features of the temperature and salinity in 1954 are about the same as those described for the Kattegat (see p. 00).

Especially high salinity anomalies were found at the bottom during July-September indicating a strong inflow from the Kattegat (comp. Table 1).

At the surface the temperatures were about the same as in the Kattegat but at the bottom a positive anomaly of one degree was found at Halsskov Rev as late as April and here the cooling of the bottom layer due to the cold winter did not happen till May when the temperature became about normal. During July, August, and September the bottom temperature was 2—1° C. below normal as a result of the inflow of saline water which has a negative temperature anomaly during the summer.

HELGE THOMSEN.

the bottom layer water from the Kattegat (28—31‰ S, 6—8°C.). They were separated by a discontinuity layer of 5—10 m. thickness. In the Little Belt the vertical salinity gradient was only half of that in the Great Belt. Here the discontinuity layer was not so marked and sank down to 12 m., so that the entrance of water of high salinity from the north was stopped by the 10.5 m. high ridge near Assens.

Table 2. Hydrographic Measurements in the Great Belt and Little Belt, June 1954.

	Kelds Nor		Halsskov Rev		E. of Lillegrund		Æbelø	
	54°44' N., 10°46.5' E.		55°20.1' N., 11°2' E.		55°39' N., 10°45' E.		55°40.3' N., 10°10' E.	
Date	15.6.		16.6.		16.6.		16.6.	
m.	°C.	‰ S	°C.	‰ S	°C.	‰ S	°C.	‰ S
0	14.96	13.53	14.33	14.01	15.25	15.37	15.10	19.16
5	—	13.70	15.01	14.64	14.79	15.96	14.90	19.16
10	10.95	21.59	8.42	27.01	9.22	26.23	10.91	22.29
15	8.17	26.62	6.28	31.01	—	—	6.47	30.54
20	7.59	28.17	5.56	31.94	4.49	33.11	5.75	31.63
30	6.32	30.29	5.06	32.91	4.08	33.32	—	—
60	—	—	4.94	33.05	—	—	—	—

German Observations.

1. The Belts and the Baltic.

Sections through the Great Belt and the Little Belt to Kiel Bay in the middle of June give a picture of the hydrographic conditions in the Belt Sea. Observations at some of the stations are shown in Table 2.

The hydrographic conditions in the Great Belt were characterized by the occurrence of two water masses: the surface layer was water from the Baltic (12—15‰ S, 14—17°C.), and

	Fanø		N. of Als		S. of Ærø		Fehmarnbelt	
	55°28.7' N., 9°41' E.		55°8' N., 9°45.5' E.		54°41' N., 10°30' E.		54°36.3' N., 11°1' E.	
	17.6.		17.6.		18.6.		18.6.	
m.	°C.	‰ S	°C.	‰ S	°C.	‰ S	°C.	‰ S
0	15.09	17.37	16.60	14.11	16.10	13.68	16.41	12.09
5	14.65	18.48	16.41	14.15	16.00	13.86	15.25	12.65
10	11.79	23.03	16.26	14.15	15.69	14.29	13.95	14.60
15	10.34	25.12	10.12	20.31	10.15	18.33	11.09	19.88
20	—	25.73	7.98	22.75	8.59	25.92	7.49	27.45
25	—	—	—	—	7.81	27.67	6.97	28.89
30	9.59	26.29	5.08	25.90	—	—	6.82	29.30
40	9.48	26.41	5.08	26.33	—	—	6.82	29.38
80	7.78	28.62	—	—	—	—	—	—

Table 3. Hydrographic Measurements in the Western and Central Baltic, July 1954.

(From G. WÜST und W. BROGMUS, 1955.)

m.	Date	Fehmarnbelt 54°34.8'N., 11°16.8'E.			Kadett Groove 54°24.5'N., 12°07.5'E.			Arkona Basin 55°06'N., 14°01'E.		
		°C.	‰S	O ₂	°C.	‰S	O ₂	°C.	‰S	O ₂
0		15.14	15.52	—	15.96	12.25	—	14.34	7.86	—
5		15.02	15.53	—	15.97	12.36	6.59	14.05	7.86	—
10		13.79	18.21	—	14.98	13.59	—	13.23	7.85	—
15		11.75	21.47	6.72	13.97	17.45	6.56	11.67	7.79	—
20		7.66	29.34	6.58	7.28	28.06	6.18	8.56	7.81	—
25		6.87	30.41	6.48	—	—	—	5.60	7.97	—
30		—	—	—	—	—	—	5.55	8.17	8.07
40		—	—	—	—	—	—	8.77	15.66	—
47		—	—	—	—	—	—	6.03	19.65	4.82

m.	Date	Bornholm Deep 55°19'N., 15°12.8'E.			W. of Gotland 57°26.5'N., 17°40'E.		
		°C.	‰S	O ₂	°C.	‰S	O ₂
0		14.84	7.79	—	13.84	7.39	—
15		13.72	7.79	—	13.32	7.39	—
20		5.27	7.77	—	—	7.41	—
30		—	7.83	—	5.45	7.39	8.06
40		3.74	7.97	8.78	4.05	7.50	8.01
60		5.12	15.64	6.65	3.56	8.30	5.90
70		6.13	17.21	—	4.60	10.25	1.65
80		6.29	17.43	6.51	—	10.64	1.52
100		6.20	17.65	5.88	4.92	10.91	1.10

South of this ridge remains of older water of 26‰ S and 5°C. were found. The new bottom water of high salinity in the Kiel Bay had entered through the Great Belt.

These observations were continued in a section from the Kiel Bay through the Arkona and Bornholm basins to the western Gotland basin in the beginning of July. A detailed paper on this subject¹⁾ has just been published. As characteristic of the hydrographic situation at this time, the observations at some important stations are given in Table 3.

For further details and for general conclusions drawn from the temperature and salinity sections, see the publication by G. Wüst and W. Brogmus. In it they describe the strong morphological influence on stratification, and discuss the multiple warm and cold water layers, especially in the transition layer, and the higher salinity and stronger aeration in the bottom water in comparison with sections made earlier.

In connexion with the observations in the Great Belt in June 1954, it may be mentioned that bottom water of 28—30‰ S and about 7°C., coming from the Kattegat, extended up

to the Kadett Groove. The bottom water in the Arkona and Bornholm basins (17—19‰ S and about 6°C.) was apparently formed by the mixing of this influx of water from the Kattegat with the cold water forming the lower part of the upper layer of low salinity. The relatively high oxygen content of the bottom water (61% and 75% respectively) proved that this inflow had replaced the old water of 20‰ S and with an oxygen content of less than 2% saturation, which was still present at the bottom in the middle of September 1953 (Ann. Biol., 10, p. 134). On the contrary, in the western Gotland basin, no renewal of the bottom water had taken place since summer 1953. The transition layer was still located at about 60 m., and the oxygen content of the bottom water was low; but there was a little increase by 0.2‰ in the salinity both in the upper and lower layers.

R. KÄNDLER.

2. The Western Baltic.

Partly in 1948 and almost continuously since 1949, daily surface observations (0800) of temperature and salinity have been carried out by German lightships in the western Baltic. The individual values will be published in the form of a yearbook under the title of "Meereskundliche Beobachtungen und Ergebnisse".

¹⁾ G. WÜST, & W. BROGMUS. "Ozeanographische Ergebnisse einer Untersuchungsfahrt mit Forschungskutter "Süd-fall" durch die Ostsee Juni-Juli 1954". Kieler Meeresforsch., 11, 1955.

Table 4. Monthly Means of Salinity and Temperature in the single Years 1948-1954 at Surface and Bottom for the German Lightvessels "Flensburg", "Kiel" and "Fehmarnbelt".

(From Deutsches Hydrographisches Institut, Hamburg).

Month		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity "Flensburg"							Surface						
	1949	—	—	—	17.08	16.01	15.94	15.82	17.40	14.02	15.51	19.20	19.29
	1950	18.90	17.41	18.19	18.42	14.86	16.89	17.72	17.48	19.06	23.46	20.88	20.18
	1951	19.18	16.61	16.64	19.03	15.70	14.55	15.51	16.35	16.73	16.81	16.62	24.15
	1952	25.12	21.73	18.07	15.41	14.83	17.14	17.85	16.30	18.28	18.81	16.52	16.26
	1953	15.43	17.87	18.48	17.16	13.23	12.43	13.82	18.28	20.37	18.10	16.36	19.78
	1954	20.28	17.92	15.88	17.05	15.38	15.07	19.44	19.82	19.68	18.89	21.56	19.04
"Kiel"							Surface						
	1949	—	—	—	15.68	14.45	13.86	12.27	14.50	12.75	15.83	19.07	18.80
	1950	18.59	17.45	17.58	17.76	14.38	14.68	16.53	16.02	17.78	22.44	20.90	20.06
	1951	18.82	17.79	17.30	17.88	15.08	13.08	14.19	14.52	15.81	15.79	16.77	22.31
	1952	24.53	19.30	17.67	14.58	13.19	14.81	14.35	13.98	16.19	17.26	17.41	16.70
	1953	15.52	17.42	16.21	15.62	12.21	11.79	12.20	15.71	15.57	17.06	17.71	19.46
	1954	18.81	17.49	16.96	16.41	14.41	13.51	16.87	18.43	17.29	20.78	20.45	19.14
"Fehmarnbelt"							Surface						
	1949	—	—	—	13.76	11.16	11.71	10.76	13.09	9.86	15.83	15.75	18.79
	1950	13.32	15.54	13.54	12.66	9.80	12.84	13.57	11.54	18.68	18.84	14.83	15.21
	1951	14.93	11.83	15.59	14.32	10.09	10.99	13.37	12.02	12.78	12.29	14.87	20.45
	1952	18.27	15.13	11.94	12.05	11.56	13.92	12.13	11.49	14.39	13.00	12.54	13.34
	1953	13.50	14.38	12.17	11.20	9.64	9.05	11.49	13.82	14.80	12.94	15.74	16.59
	1954	17.20	11.10	14.37	14.66	10.57	11.83	15.27	11.69	16.14	16.85	15.68	16.31
"Fehmarnbelt"							Bottom						
	1949	—	—	—	17.48	26.02	28.57	27.05	25.01	24.94	22.19	21.93	20.93
	1950	19.19	20.17	21.19	26.06	27.05	27.80	27.03	25.08	24.91	23.00	21.01	20.06
	1951	21.35	24.65	24.87	24.39	24.85	26.40	28.86	26.71	27.02	26.44	26.00	26.10
	1952	23.19	21.67	20.33	24.15	28.11	27.85	27.82	26.23	21.63	18.44	18.34	18.57
	1953	21.94	19.72	17.03	20.40	26.07	27.39	29.33	28.97	27.23	24.68	22.11	24.05
	1954	20.46	19.17	26.32	27.72	26.42	29.07	29.49	28.12	26.23	21.10	18.76	19.32
Temperature "Flensburg"							Surface						
	1948	3.1	1.8	1.5	—	—	15.8	16.3	17.9	14.7	11.6	7.8	5.3
	1949	3.2	2.8	2.2	5.5	10.3	13.6	16.9	15.7	17.3	14.0	8.5	6.0
	1950	2.8	1.8	2.8	5.7	10.7	13.2	14.1	16.0	13.0	9.4	5.1	4.2
	1951	2.2	1.3	1.4	4.2	9.4	14.9	15.7	17.5	16.4	12.2	9.2	6.9
	1952	4.0	1.9	2.4	5.2	10.7	12.2	16.1	17.6	14.0	12.7	6.4	3.4
	1953	1.7	1.4	2.7	6.1	11.2	15.0	17.7	15.9	13.9	12.0	10.3	7.1
	1954	3.8	-0.5	+0.4	3.5	10.3	15.4	13.8	15.2	14.7	11.3	8.4	5.0
"Kiel"							Surface						
	1948	3.3	2.4	2.3	6.0	10.7	14.8	16.6	17.8	15.1	11.6	7.7	5.2
	1949	3.4	2.7	2.3	5.5	10.7	14.0	17.5	17.3	17.2	14.0	8.8	5.9
	1950	3.1	1.6	2.9	5.7	10.3	14.7	16.7	18.3	15.9	12.0	7.5	4.2
	1951	2.1	1.3	1.5	4.3	8.8	14.0	16.4	17.3	16.2	12.3	9.5	6.7
	1952	3.9	1.8	2.2	5.7	10.2	13.4	16.0	16.5	14.3	10.5	7.0	3.1
	1953	1.5	1.2	2.6	6.0	11.0	14.3	18.1	16.5	14.0	12.1	9.8	6.3
	1954	2.9	-0.2	+0.2	3.7	9.5	15.0	15.2	15.1	14.6	11.5	8.0	5.1
"Fehmarnbelt"							Surface						
	1948	2.9	2.1	2.5	5.6	10.2	14.7	16.6	17.7	15.0	11.2	7.4	4.7
	1949	3.1	2.3	2.1	4.5	9.8	13.6	16.8	16.8	16.7	13.6	9.0	5.8
	1950	2.7	1.6	2.6	5.6	9.5	15.1	16.6	18.1	15.7	12.2	8.0	4.7
	1951	2.5	1.6	1.7	4.9	8.2	14.1	16.1	17.0	16.1	12.1	9.3	6.6
	1952	3.9	2.3	2.5	5.8	10.0	13.2	15.8	16.6	14.3	10.4	6.8	3.6
	1953	2.3	1.1	2.6	5.7	10.0	13.9	18.2	17.0	14.4	12.4	9.8	6.4
	1954	3.2	0.0	0.8	4.4	9.3	14.5	15.1	15.0	14.8	11.4	8.3	5.4
"Fehmarnbelt"							Bottom						
	1949	—	—	—	4.1	5.8	7.3	8.5	11.3	12.3	13.7	10.6	6.4
	1950	3.9	2.2	2.8	4.8	5.8	7.2	8.8	10.6	14.0	12.5	8.8	5.3
	1951	4.0	4.0	3.5	3.4	4.9	7.2	12.5	14.2	(16.4)	12.4	11.5	6.9
	1952	4.4	2.4	2.4	3.5	4.9	7.0	8.0	9.7	12.6	11.7	8.7	5.3
	1953	4.5	2.3	2.1	4.1	5.3	6.7	7.8	8.9	9.8	11.2	10.7	8.1
	1954	4.2	1.1	3.4	4.4	5.4	6.8	7.8	9.2	10.2	11.5	8.9	5.5

The observations made by lightships "Fehmarn-belt" ($54^{\circ}36' \text{ N.}$, $11^{\circ}09' \text{ E.}$) are approximately representative for areas of the Baltic with strong in-going and out-going currents; the observations from lightships "Kiel" ($54^{\circ}29.9' \text{ N.}$, $10^{\circ}18.5' \text{ E.}$) and "Flensburg" ($54^{\circ}50.3' \text{ N.}$, $9^{\circ}53.8' \text{ E.}$) are typical for the border zones of the western Baltic away from the strong current. Hydrographical observations at various depths were carried out only by "Fehmarn-belt" lightship, and then only once a day. In Table 4 mean values of bottom observations are given.

Surface temperatures in 1954, especially in spring, have been exceptionally low compared with the values obtained for the years 1948—1953. The surface salinity values show the well-known strong fluctuations from month to month, however these get less variable with increasing distances from the entrances to the Baltic, viz., from "Fehmarnbelt" to "Flensburg" and "Kiel".

G. DIETRICH.

Table 5. Monthly Means of Surface Temperature and Salinity at Christiansø, 1954.

	I	II	III	IV	V	VI
Temperature	4.2	1.2	0.9	2.1	6.6	14.0
Salinity ‰	7.7	7.6	7.6	7.7	7.7	7.9
	VII	VIII	IX	X	XI	XII
Temperature	15.1	14.3	13.0	9.7	7.2	4.8
Salinity ‰	7.6	7.5	7.5	7.6	7.6	7.5

Danish Observations at Bornholm.

Surface. (Table 5).

The monthly mean temperatures of the surface water were generally below normal with the exception of June, where a mean temperature of 3.0° above normal was recorded, and January and May, which had mean temperatures slightly above normal.

The monthly mean salinities were slightly above normal throughout the year.

The Bornholm Deep.

The extremely high-saline water which entered the Bornholm Deep by the end of 1951

Table 6. Monthly Means of Salinity and Temperatures in 1954 at Surface and Bottom at Swedish Lightships and Deviations from the 30-Year Means.

Salinity	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Surface												
Sydöstbrotten.....	5.12	—	—	—	4.68	4.87	4.99	4.29	5.36	5.88	5.82	5.75
Deviation.....	-0.3	—	—	—	-0.1	+0.2	+0.7	0.0	+0.8	+1.0	+0.6	+0.4
Grundkallen.....	5.78	5.85	—	5.93	5.90	—	5.68	5.54	5.57	5.37	5.55	5.74
Deviation.....	+0.4	+0.4	—	+0.5	+0.5	—	+0.5	+0.4	+0.4	+0.1	+0.1	+0.4
Svenska Björn.....	6.58	6.90	—	6.84	6.16	5.95	5.91	5.67	5.84	6.15	6.09	6.46
Deviation.....	+0.4	+0.7	—	+0.8	+0.3	+0.2	+0.4	+0.2	+0.2	+0.2	0.0	+0.3
Falsterborev.....	8.18	8.25	—	7.73	7.86	7.60	8.34	8.56	8.77	10.49	9.12	8.08
Deviation.....	0.0	+0.2	—	+0.2	+0.4	+0.1	+0.5	+0.7	+0.8	+2.0	+0.9	-0.2
Oskarsgrundet.....	8.70	—	8.25	—	8.49	8.29	12.29	8.91	18.55	14.55	10.95	8.31
Deviation.....	-2.4	—	-2.0	—	+0.1	-1.5	+2.4	-0.7	+7.8	+3.7	+0.4	-3.7
Bottom												
Sydöstbrotten.... 40	5.73	—	—	—	5.85	5.97	5.93	5.75	5.88	5.88	5.84	5.87
Grundkallen.... 40	5.99	5.99	—	5.93	5.95	—	6.00	5.92	6.38	5.81	5.74	5.81
Svenska Björn.... 40	7.01	6.92	—	6.91	6.66	7.00	7.29	7.34	6.23	7.41	7.21	6.49
Falsterborev.... 10	8.18	8.22	—	7.75	7.86	7.65	9.19	8.87	9.56	10.51	9.75	8.12
Oskarsgrundet.... 8	8.78	—	30.89	—	8.49	18.30	16.74	8.92	21.55	21.16	22.03	12.12
Surface												
Sydöstbrotten.....	1.7	—	—	—	4.5	8.8	13.9	15.3	13.9	9.2	6.6	3.2
Deviation.....	-0.4	—	—	—	+0.1	+0.4	-0.2	-0.1	+2.0	+1.5	+1.8	0.0
Grundkallen.....	—	—	—	0.5	3.3	8.6	14.7	15.8	12.8	7.6	5.2	3.3
Deviation.....	—	—	—	-0.6	+0.1	+0.4	+0.4	-0.1	0.0	-1.1	-0.6	-0.2
Svenska Björn.....	3.2	1.2	—	1.2	4.3	9.3	14.2	15.0	12.7	8.2	—	4.6
Deviation.....	+0.8	0.0	—	-0.5	+0.1	+0.4	-0.5	-0.8	+0.4	+0.8	—	+0.3
Falsterborev.....	3.0	—	—	2.5	8.3	14.6	13.5	14.0	14.2	10.1	7.6	5.1
Deviation.....	+0.1	—	—	-1.2	+0.5	+2.2	-2.3	-2.5	-0.5	-1.6	-0.8	0.0
Oskarsgrundet.....	1.9	—	—	—	8.6	15.4	14.4	14.1	14.2	10.5	7.8	5.4
Deviation.....	-0.9	—	—	—	+0.2	+2.3	-1.7	-2.6	-0.6	-0.9	-0.2	+0.7
Bottom												
Sydöstbrotten.... 40	2.5	—	—	—	0.5	1.4	3.3	2.6	6.7	9.1	—	3.8
Grundkallen.... 40	—	—	—	0.5	1.9	2.8	3.3	3.7	6.6	5.5	5.0	3.2
Svenska Björn.... 40	3.8	1.9	—	1.0	2.3	3.4	3.7	4.3	4.7	5.9	—	4.8
Falsterborev.... 10	2.9	—	—	2.4	7.2	13.8	12.7	11.9	13.9	10.2	7.7	5.0
Oskarsgrundet.... 8	2.1	—	—	—	8.4	12.4	14.3	14.1	14.1	10.8	7.9	6.2

Table 8. Salinities (‰) at Finnish Stations in the Central Baltic and the Northern Bothnian Bay in 1954 (see Figure 1) and Differences from these in previous Years (in 100 ‰).

m.	1954	1939	1921—30	1903	m.	1954	1939	1925	1903
F 3	$\frac{2}{8}$	$\frac{16}{7}$	$\frac{22}{7}$	$\frac{15}{8}$	F 78	$\frac{17}{7}$	$\frac{8}{7}$	$\frac{11}{7}$	$\frac{7}{8}$
0	3.32	-53	-31	-93	0	6.42	-60	-18	-49
10	3.33	-39	-23	-52	10	6.46	-55	+ 1	-53
20	3.28	-20	0	+ 7	20	7.02	-56	-31	-33
30	3.39	-26	- 6	+ 7	30	7.34	-76	-45	-49
40	3.46	-33	-10	+ 5	40	7.39	-46	-37	-39
50	3.53	-34	-12	+13	50	7.56	-36	-40	-47
60	3.63	-39	-14	+ 9	60	7.70	+54	-47	-52
70	3.87	-43	-25	- 3	70	9.15	+36	-167	-76
80	3.93	-45	—	- 6	80	10.43	-63	-166	-145
90	3.95	-45	—	- 6	90	10.77	-67	—	—
F 12	$\frac{1}{8}$	$\frac{15}{7}$	$\frac{22}{7}$	$\frac{14}{8}$	100	10.95	-67	—	-144
0	3.48	-35	-23	0	125	10.99	-42	-89	-116
10	3.50	-37	-22	- 2	150	11.09	-39	—	-120
20	3.50	-28	-14	0	175	11.26	-51	—	—
30	3.53	-23	-13	0	200	11.40	-63	—	-139
40	3.60	-27	-14	- 0	225	11.44	-65	-118	—
50	3.71	-30	-14	- 5	250	11.51	-69	—	—
60	3.91	-43	-22	-16	275	11.56	-68	—	—
70	4.11	-49	-32	-18	300	11.50	-68	—	-131
80	4.31	-54	-40	-20	325	11.56	-65	—	—
90	4.29	-47	-31	-14	350—400	11.64	-73	-141	-145
100	4.34	-52	-27	18					
110	4.36	—	—	—	F 81	$\frac{24}{7}$	$\frac{8}{7}$	$\frac{17}{7}$	$\frac{7}{11}$
F 24	$\frac{31}{7}$	$\frac{14}{7}$	$\frac{20}{7}$	$\frac{12}{8}$	0	7.11	-42	-24	-28
0	4.94	-20	-29	-25	10	7.11	-29	-28	—
10	5.17	-47	-41	-34	20	7.23	-34	-23	-36
20	5.30	-22	-10	-14	30	7.48	-57	-43	—
30	5.59	-40	-21	- 4	40	7.59	-56	-44	-68
40	5.79	-49	-31	-15	50	7.65	-40	-44	-54
50	5.91	-45	-38	-25	60	7.72	-36	-34	-40
60	5.99	-38	-37	-33	70	8.04	-18	+ 3	-14
70	6.13	-40	-44	-38	80	9.56	-45	-51	-50
80	6.40	-52	-64	-54	90	10.77	-76	-105	-128
90	6.53	-60	-69	-56	100	11.38	-77	-107	-157
100	6.60	-63	-70	-56	125	12.16	-58	-108	-125
125	6.69	-69	-74	-60	150	12.85	-87	-126	-179
150	6.71	-67	-73	-58	175	13.10	-83	—	-136
175	6.74	—	—	-59	200	13.22	-66	—	-153
					225	13.50	—	—	-201

Table 8 shows the salinities at some typical stations in the Bothnian Bay, the Bothnian Sea, and the North Baltic, as obtained during the cruise with "Aranda" in the summer of 1954 (Figure 1). These salinities are compared with those found during the preceding cruise, in 1939 (Merentut. Julk., 128), the mean salinities of the years 1921—30 (Merentut. Julk., 122), and the salinities observed during the first complete Finnish summer cruise, in

1903 (Hydrogr.-Biol. Unters., 1, 1907). The table gives the differences from the new values. The full material will be published in Merentut. Julk., 166.

A corresponding comparison of the temperatures has been carried out too, but no uniform trend of the kind evident in the changes in salinity could be observed.

G. GRANQVIST.

Plankton.

Danish Observations of the Fat Content.

As in previous years the fat content of the plankton was determined in samples taken by vertical hauls with the Hensen net from the S/S "Biologen" during its annual quantitative and qualitative cruise for the young of the fish stocks. In addition the collection of plankton at the fixed station at Christiansø, NE. of Bornholm, was continued. The fat percentages were as follows (number of stations in brackets):—

Date.....	1953		1954	
	12/8—20/9		28/8—4/9	
	Mean	Range	Mean	Range
At Møen.....	15 (2)	14—15	6 (1)	—
S. of Scania.....	23 (3)	21—25	7 (5)	4—10
At Bornholm.....	32 (9)	17—38	7 (10)	5—10

At the fixed station at Christiansø in 1954.

Date.....	28/4	7/5	16/6	6/8
Fat %.....	6	5	5	5

In 1954 the fat contents were extremely low, which undoubtedly must be ascribed to the cold and cloudy summer. On the other hand the fat content of the herring in the one and only sample investigated, caught 10/9 SE. of Bornholm, was astonishingly high. For the small immature fish of 18—20 cm. length it was 19.4% and for the larger immature fish of 22—25 cm. 14.8%, whereas on 15/10 1953 it was found to be 10.9%. Previously it has been found that the fluctuations in the fat content of the herring seemed to follow those in the fat of the plankton, but the relationship seems to be more complicated.

AA. J. C. JENSEN.

Benthonic Food.

During the cruise of the research ship M/S "Aranda", made in the summer of 1954, quantitative bottom samples were taken at all depth stations.

Four species were found further to the north or further to the east than previously reported.

Pontoporeia femorata KRÖYER was found, in addition to a number of other stations, at the station F 33 at 60°33'N., 18°55'E. Previously it has been found in the middle part of the Åland Sea.

Halicryptus spinulosus v. SIEB. was found as far to the north as the station F 27a 61°44'18"N., 21°19'05"E. (Figure 2). Previously it has been reported from the northern boundary of the Archipelago Sea.

Pygospio elegans CLAPARÈDE was also found at the station F 27a and besides at the station F 48b at 60°06.5'N., 25°25'E. (Figure 2). Hitherto it has been reported from the region around Tvärminne and from Laajalahti in Helsinki.

Scoloplos armiger (O.F.M.) was found, among others, at the station F 66B at 59°42.5'N.,

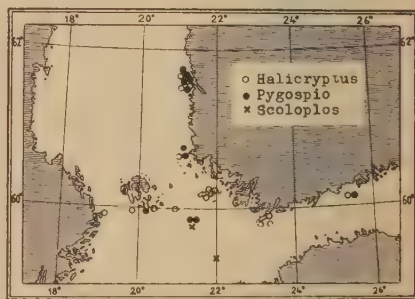


Figure 2. Localities where *Halicryptus spinulosus*, *Pygospio elegans* and *Scoloplos armiger* were found during the summer cruise of 1954.

21°18.5'E. (Figure 2). This is the first time it has been found in Finnish waters.

That these species now are found further to the north or east than previously may be explained by the incompleteness of the investigations conducted until now, but may as well be connected with the marked increase in salinity in the Baltic.

VEIKKO SJÖBLOM.

THE FISH

Eggs and Larvae.

Danish Investigations.

Flatfish. In hauls with the 2 m. stramin-net in the Great Belt in March a few days after the ice had melted no larvae of flatfish were found; also all other plankton was extremely scarce. In hauls in the Belts in May no larvae of plaice were found, which was to be expected on account of the cold winter, but the number of larvae of flounder was larger than normally. The dab larvae were proportionately few but a great number of eggs were found which perhaps were dab eggs.

AA. J. C. JENSEN.

German Investigations.

In the 1954 breeding period, the average numbers of eggs per m², near the lighthouse "Fehmarnbelt" in each month were as follows:

		Dec.	Jan.	Feb.	March
Cod	1954	35 ¹⁾	5	4	83
	1934—43	4	15	81	49
Plaice	1954	—	—	—	—
	1934—43	0.5 ¹⁾	0.5	2	1
Flounder	1954	—	—	—	32
and Dab	1934—43	—	—	8	23
Sprat	1954	—	—	—	—
	1934—43	—	—	—	—
Mackerel	1954	—	—	—	—
	1934—43	—	—	—	—

		Apr.	May	June	July	Aug.
Cod	1954	59	5	—	—	—
	1934—43	24	3	1	—	—
Plaice	1954	1	1	—	—	—
	1934—43	1	—	—	—	—
Flounder	1954	62	32	28	8	—
and Dab	1934—43	35	35	18	3	—
Sprat	1954	—	—	12	5	—
	1934—43	—	22	60	60	5
Mackerel	1954	—	—	8	7	—
	1934—43	—	—	1.5	0.2	—

¹⁾ Second half of month.

The spawning of the cod began in December 1953, but was interrupted for two months because of low temperature, as in the previous year.

The maximum egg number per m² for each species during the time of year is for cod and flounder: beginning of April (108 and 137 resp.); for dab: beginning of June (63); for sprat: middle of June (21); for mackerel: second half of June (20). In comparison with the years 1934—43, the intensity of spawning of cod, flounder, and dab was normal and

stronger than the previous year; on the other hand, that of the sprat was below normal and lower than even in 1953. The number of mackerel eggs had doubled compared with 1953 and had almost reached that of sprat eggs. As before, the eggs of plaice show the lowest frequency.

At 23 stations from the research cutter "Südfall" round Fyn in the middle of June (15.—18.) the distribution and frequency of the eggs and larvae of other fishes, of decapod larvae, and of medusae showed a similar picture. The movement of pelagic larvae of fish and bottom animals from the Kattegat into the Kiel Bay takes place almost exclusively through the Great Belt. In this process the Little Belt in general plays only an unimportant role, as a result of its position and morphology.

In the southern Baltic at the beginning of July, the following numbers of fish eggs per m², were counted:—

	Arcona Basin	Bornholm Basin	
	55°06'N.,	55°19'N.,	55°32.5'N.,
	14°01'E.	15°12.8'E.	15°41'E.
	49 m.	114 m.	82 m.
Date	² / ₇	¹ / ₇	¹ / ₇
Cod.....	3	67	64
Sprat.....	—	22	12
Dab.....	1	5	1

R. KÄNDLER.

Plaice, Flounder, and Turbot.

1. Coastal investigations, 0- and I-groups.

The numbers of 0-group plaice caught with a Johansen young-plaice-trawl were (see Table 9) very small in the Belts and the Sound; in the western Baltic the numbers were a little above the normal, and at Bornholm they were relatively abundant. On account of the cold winter we expected a low number of plaice of this year-class in the Belt Sea and the Sound, and as a whole this was observed. However, the distribution is abnormal in that it would seem that the strong ingoing currents during the first months of the year carried an unusually great number of larvae from the Belts into the western Baltic. The average number of the anal fin-rays of the 0-group plaice in this area was 51.0 (21 spec.) and in the largest of them it was still higher, which indicates that indigenous larvae in this region in 1954 were

Table 9. Number of 0-Group Plaice, Flounder, and Turbot caught per Hour with the Johansen Young-Plaice-Trawl. At Bornholm also with the Hand-Push-Net (H.P.).

Preliminary figures. In italics means for longer series of years.

	No. of stat.	Plaice	Flounder	Turbot
Belts.....	49	3 28	0.4 0.2	0 2
Western Baltic.....	7	7 14	2 1	0 1
Sound.....	15	3 28	10 5	0 2
E. coast of				
Seeland-Falster....	8	0 3	— —	0 4
At Bornholm.....	8	38 —	76 —	9 —
— (H.P.)...	21	50 17	93 231	37 25

mixed more than usual with larvae brought in from the Belts.

The number of I-group plaice found in the coastal investigations was greater than normal in the Belts, the western Baltic, and in the Baltic proper on the east coast of Falster. Perhaps there has been an immigration of young fish from more northerly regions.

The number of 0-group flounder was above normal in the Belt Sea and the Sound and below normal on other Danish coasts of the Baltic-Belt Seas. The numbers of 0-group turbot were very low except at Bornholm, although they were here also below normal.

2. The stock of plaice in the open sea.

The total numbers of plaice caught in the Belt Sea per hour with the standard trawl of S/S "Biologen" in the years 1953 and 1954 are shown in Table 10 together with the average catch during 1927—39.

The very great decrease from 1953 to 1954 is mainly due to the decrease in the number of the strong 1952 year-class owing to depletion by the fishing, but it is seen that the stock was considerably larger than in 1927—39. Almost all of the plaice found in 1954 in the Belt Sea were between 15 and 30 cm. long, and most of them were of the II-group, but age determinations have, up till the present, only been carried out on a small part of the material, and figures for the age distribution cannot therefore be given as yet. None of the plaice fished were of the 0-group, but the I-group was found in considerable numbers in parts of the Great Belt.

The rich year-class has resulted in very prolific fishery for plaice in this region during 1954. At the end of the year a considerable

Table 10. The Total Number of Plaice caught per Hour with Trawl.

The numbers of plaice caught with the eel-tog have been converted to trawl/hour by multiplying by 3. The 0-group means have been calculated from hauls made after 1. July. In brackets number of stations.

	Mean 1927—39	1952	1953	1954
Belts				
5—14 m.	51	272	829	89 (22)
15—34 m.	28	8	33	30 (59)
> 35 m.	—	0	—	6 (2)
W. Baltic				
5—14 m.	—	4	—	—
15—34 m.	—	4	3	4 (20)

part of the stock was below the size limit consisting mostly of the smallest of this year-class but also including more or less of the I-group. Even in 1955 the yield of the plaice fishery is likely to be comparatively good. For the Sound and the Baltic proper the age distribution is shown in Table 11. It is seen that in the Sound the plaice are older than in the other areas as is normally the case. The reason is that trawl-fishing here is prohibited. In the westernmost parts of the Baltic proper the II-group was the most prominent but at Bornholm there seems to have been about as many of the III-group.

The length distribution in one part of the Belts in the last quarter of the year is shown in Table 12. It is seen that the 0-group (the 1953 year-class) of 6—10 cm. length was relatively abundant in 1953, the I-group plaice, which were mostly 16—25 cm. long, constituted the major part. The number of stations at depths less than 15 m. where most of the young plaice are found, were so few in 1954 that we cannot trust the results very much. It may be

Table 11. Numbers of various Age-Groups of Plaice caught per Hour in Trawl from S/S "Biologen" in the Sound and the Baltic in 1954. (Preliminary figures).

	No. of stat.	II	Age-groups III	IV	V+	Total
Sound						
5—14 m.	6	3	2	2	0.3	7
15—35 m.	5	4	8	11	5	28
Moën Region						
15—24 m.	9	8	3	0.4	0.2	11
25—35 m.	2	16	1	—	—	17
S. of Scania						
40—45 m.	5	3	1	1	—	5
Round Bornholm						
39—43 m.	5	1	1	—	—	2
73—78 m.	6	0.3	0.7	—	—	1

doubtful if the numbers of the 1953 year-class were reduced as much, (to about half as it can be seen here), but no doubt the great reduction of the number of the II-group is real. Many of these plaice have reached the size when they are removed by the intensive fishery, and we must not forget that the fishery also reduces the number of plaice just under the minimum size because the mesh sizes used will also catch some undersized fish in order to get as much as possible of the commercial fish. Even if they are sorted from the catch immediately after they have been taken onboard, and even if, on account of the soft-meshed implements used in these waters, they are not damaged very much by being caught once and released again, their repeated capture and their subsequent measuring to see if they have reached the required length will cause damage.

Table 12. Length Distribution of Plaice caught per Hour with Trawl from S/S "Biologen" in October-November-December 1953 and 1954 in the Samsø Region and in the Great Belt.

No. of stat. cm.-group	5—14 m.		15—35 m.	
	1953	1954	1953	1954
	7	2	14	20
6—10.....	309	3	1	—
11—15.....	197	128	2	0.1
16—20.....	241	104	9	6
21—25.....	173	48	32	12
26—30.....	9	14	8	10
31—35.....	1	5	1	6
36—40.....	—	—	0.3	2

Moreover it is seen from the table that the number of plaice over the size limit had increased by about double from 1953 to 1954 on account of the rich 1952 year-class. In July-August (when more hauls from the same regions are available) the number of commercial plaice caught per hour increased at depths over 15 m. from 4 to 19 from 1953 to 1954.

Corresponding with the increase in the number of commercial plaice the fishery in 1954 was very often most productive and the total catch increased in the Belts to 3 times the catch in 1953 (in metric tons):—

	Belts	W. Baltic	Sound	Baltic proper
1953.....	886	104	20	278
1954.....	2555	157	34	275

The length distribution of plaice in the Sound in August caught per hour at depths over 15 m. are compared with catches in July-August in the regions of the Belts mentioned above:—

	No. of stat.	Length-groups, cm.									
		11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-55		
Part of Belts.....	13	2	6	19	17	2	0.3	—	—		
Sound.....	5	—	0.4	1	2	6	7	6	2		

The effect of the fishery with seines and trawls can hardly be illustrated more distinctly than by this example.

AA. J. C. JENSEN.

3. Transplantation of plaice.

Due to the difficulties experienced in getting the necessary numbers of young plaice from the coast at Esbjerg, transplantation from this area is now abandoned and all the plaice transplanted in 1954 were caught in Nissum Broad. It was intended to transplant 144,000 kg. to the Belt Sea but as the work could not be commenced before the 31. March and as the stock of plaice was unusually small, the transplantation was delayed to such a degree that the rising temperature made it necessary to close the experiment on 12. May before the total amount was reached. In total 99,590 kg. or 1,405,500 specimens were liberated: 30,880 kg. at Endelave north of Fyn, 26,550 kg. in Little Belt, 8,730 kg. in Sejro Bay, 8,490 kg. in Aarhus Bay, 8,850 kg. in Isefjord, 4,240 kg. in "Smålandshavet" south of Seeland, 4,590 kg. at Thurø south-east of Fyn, 3,760 kg. at Bagenkop south of Langeland, and 3,500 kg. in Kalundborg fjord.

In total 900 of the plaice transplanted to the Belt Sea were marked with Petersen discs. At the end of the year only 9% were recaptured and most of these from a single load of 4,000 kg. transplanted to the Isefjord. 50% of the marked fish from this load were recaptured. Only this small part of the transplantation may have paid. Like most of the preceding years the results of the tagging experiments indicate that the transplantation methods must be improved considerably, if it is to be possible to make profitable transplantation to these areas.

O. BAGGE, E. BERTELSEN.

Dab.

The limits between the northern and southern Belts are at Fredericia and Korsør-Nyborg.

In the following figures the numbers of dabs caught per hour with trawl from S/S "Biologen" are given, number of stations in brackets:—

	1953	1954
N. Belts	478 (23)	279 (30)
S. Belts	61 (14)	43 (46)
W. Baltic	51 (3)	50 (21)
Sound	69 (4)	119 (6)
At Møen	56 (7)	22 (12)
S. of Scania	1 (5)	7 (5)
At Bornholm	0 (12)	0 (11)

It will be noted that in the Belts the number of dabs was inferior to that of the previous year, while in the western Baltic the stock remained practically unaltered. In the Belts the majority of the stock consists of young fish, the I- and II-group being by far the dominant ones. In the Sound and the western Baltic the proportion of the older age-groups was somewhat larger than in the Belts.

In the Sound the stock was larger than in 1953 but at Møen, to the south of the Sound, it had decreased; to the south of Scania and at Bornholm the dabs were scarce, as is normally the case.

J. P. JENSEN.

Flounder.

The number of flounder found in the quantitative experiments was very small. Most were fished in the "Smålandshavet" (S. of Seeland), where the average number was 18 per hour fishing with the trawl. They were mostly of the III-group, the 1951 year-class. In the Belts this year-class was the best after the good 1947 year-class, but it was below the average. It is seen that the number of flounder was considerably lower than that of the plaice.

Table 13. Number of Flounder caught per Hour in Trawl from S/S "Biologen" in 1954.

	Depth m.	No. of stat.	No. per hour
Samsø Belt, Great Belt	5—14	14	6
	15—34	28	0.3
"Smålandshavet"	13—17	17	18
Little Belt	15—35	37	2
W. Baltic	15—34	20	0.2
Sound and at Møen	15—34	21	0
S. of Scania	40—45	5	0.4
Round Bornholm	39—78	11	1.1

AA. J. C. JENSEN.

Eel.

From the summer temperature a yield of the silver-eel fishery ca. 5% under the normal

was predicted. Actually it was 5% under the mean of the previous 10 years both in the Belt Sea and in the Sound and the Baltic proper, i.e., the eastern coasts of Seeland, Møen and Falster. At Bornholm almost no silver eels are caught.

The tumour disease has spread in the Belt Sea and is found now at many localities on the smaller yellow eels, but according to reports obtained from the fishermen only about 1—2% have been affected. It may be mentioned that this is the case also in the Isefjord, and the fjords of the Kattegat coast of Jutland and the Limfjord. Also at the southern Jutland west coast a few eels with tumours are now found.

In some of the recent years a few small yellow eels with tumours at the mouth have been found in brooks near the outlet but this year two of these eels were found in the middle of Seeland, but it is possible they may have been infected in salt water.

AA. J. C. JENSEN.

Fish for Industrial Processing.

In the inner Danish waters the fishery for fish for processing is a matter of minor importance as in 1954 it amounted to 2% only of the total Danish catch of fish for this purpose and, compared with 1953, the catch has decreased 22% (Table 14).

Table 14. Catch (in tons) of Fish for Processing from the Belts.

	1952	1953	1954
Belts	3830	4332	3510
Sound	1	1	4
W. Baltic	164	123	157
E. Baltic	136	434	150
Total	4130	4890	3821

The main fishing grounds for fish for processing are: (1) the northern part of Great Belt and north of Fyn, where these catches consist of herring stage III (16—21 cm.), small herring (8—15 cm.), and sprat, whiting, and long rough dab, but sometimes the whole catch from a cutter is sold unsorted as fish for processing; (2) grounds near the northern entrance to Little Belt, where few whiting are caught and where the catches consist almost exclusively of small herring and sprat; (3) the southern part of Little Belt, where the catches consist of small herring and sprat, whiting, and a little herring stage III.

12 samples from this fishery have been investigated at the laboratory of "Danmarks Fiskeri- og Havundersøgelser". One sample originated from the closed period (15. April to 30. September), when landing of catches containing more than 50% small herring (more than 45 per kg.) is prohibited, and 11 samples are from the rest of the year (see Table 15).

Table 15. Percentage Weight of Species found in Samples from the Belts in 1954.

Period	$1/1-15/4$ and $1/10-31/12$	$15/4-30/9$	
Mesh mm. (knot to knot)	11—14	18	18—20
No. of samples	7	4	1
Whiting	23.8	6.1	0
Herring	48.3	67.4	76.8
Sprat	24.9	26.3	23.2
Other food-fishes	0.3 ¹⁾	0.2 ²⁾	—
Other fishes	2.5 ²⁾	×	—
Invertebrates	0.1	0	—
Total	99.9%	100%	100%

¹⁾ Cod, mackerel, dab.

²⁾ Long rough dab, horse mackerel, rockling, seascorpion.

³⁾ Cod.

As seen from Table 15 the main part of the samples consists of herring and sprat, while the whiting constitute 16% only, both large and small fish included. The whiting is taken in the small-meshed gears especially.

It must be remembered that these samples comprise that part only of the fish for processing which are caught by trawl with 10—20 mm. mesh-size and where either the whole catch has been sold to fish-meal factories, or where sprat have been picked out for canning, and some herring have been sold for consumption.

The following categories are also sold as fish for industrial processing:— (1) fish condemned for human consumption by the fishery control or rejected by the fishermen, mostly quantities of cod and plaice, and (2) small garfish and mackerel, and (3) in some cases other fish from the pound-nets which could not be sold otherwise. In 1954 these amounts no doubt have constituted a far less percentage of the fish for industrial processing, than in the years about 1950, when it was estimated to be about one fourth of the total quantity.

INGER BOHUS JENSEN.

Salmon.

German Catch.

The yield of salmon fishery in the south-eastern parts of the Baltic had dropped from 183 tons in 1950 to 75 tons in 1953; but it rose again to 116 tons in 1954, due to good catches in November-December. The average landing per trip which had decreased from 781 kg. in 1950/51 to 330 kg. in 1952/53, rose to 431 kg. in 1953/54 and even 594 kg. in 1954/55.

The size composition of the catches landed at the Kiel fish market which receives $\frac{3}{4}$ of the total catches, during November-December 1954 was as follows:—

Market category	V	IV	III	II	I
Gutted weight kg.	<2	2—3	3—4.5	4.5—8	>8
Number (%)	13	28	16	39	4

The two maxima in the market categories IV and II represent the salmon which have spent nearly 2 and 3 years respectively in the sea, and have grown to an average size of 65—70 cm. and 80—85 cm., respectively.

R. KÄNDLER.

Danish Catch.

The total yield of the Danish salmon fishery in the Baltic during 1954 amounted to 962 tons against 769 tons in the previous year. This improvement is particularly due to the very successful fishery during the autumn. Fishing started early in September and the period October-December yielded a total output of 550 tons, while the same period of the previous year yielded about 370 tons.

Measurements of commercial catches were carried out in March and November. In both months samples from the SE. Baltic were examined and in November a single catch from E. of Bornholm was measured. The measurements from March (Figure 3, A) show that small salmon (60 and 70 cm. group) dominated, while salmon of more than 80 cm. were present only in rather small quantities. In the November samples (Figure 3, B) from approximately the same area the small salmon are still dominant but bigger salmon (80 and 90 cm. group) now form a larger proportion

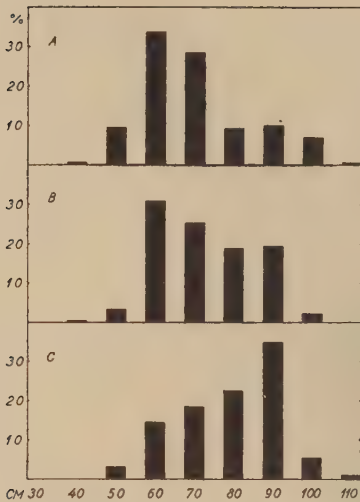


Figure 3. Length distribution of salmon caught by Danish cutters in the southern Baltic.

- A: SE. Baltic, March 1954, 336 specimens.
 B: SE. Baltic, November 1954, 537 specimens.
 C: 20 miles E. of Bornholm, November 1954, 186 specimens.

(18—20% against 7—10%) of the catches. It should also be noted that in the March sample the largest salmon (exceeding 100 cm.) form a considerably larger proportion than in the November sample. The November sample from E. of Bornholm (Fig. 3, C) shows a completely different picture, since here the 90 cm. group is dominating, forming 35% of the catch, while fish above 100 cm. form about 13%. The area from which this sample originates is not so heavily exploited by the salmon fisher as is the SE. and N. Baltic, most fishing being done by local fishermen from small boats.

The percentage of small salmon (below 3 kg., cleaned) was compiled from the fisheries statistics. It was observed that from the Baltic as a whole (no subdivision being possible) small salmon form a large proportion of the catches. In 3 months, January, October and December 60—70% of the catches consisted of small salmon, while in the previous year the highest proportion found was 56% in December.

J. KNUDSEN.

Comité Atlantique.

INTRODUCTION

Les contributions au présent rapport ont été apportées par:—

I. Hydrologie et Milieu.

R. LETACONNOUX..... France
J. LAFUSTE..... France

II. Plancton et Faune.

J. H. FRASER..... Ecosse
S. LE ROUX..... France

III. Ichthyologie.

CL. MAURIN..... Maroc

J. FURNESTIN.

LES CONDITIONS DE MILIEU

Hydrologie et Milieu.

Conditions Hydrologiques au Large du Cap Finisterre, sur les Lieux de Pêche.

Au début de Juin 1954, une nouvelle campagne a été effectuée par le «Président Théodore Tissier» dans le secteur au large du Cap Finisterre où, cette année, un retard d'une quinzaine de jours a été noté dans l'apparition du germon (*Germo alalunga*).

Des salinités variant de 35.6 à 36.0 ‰ ont été déterminées en surface, mais en liaison

avec des températures ne dépassant pas 16°. Alors que les salinités étaient sensiblement identiques à celles observées les deux années précédentes, les températures étaient par contre inférieures de 1 à 2° à celles de 1952—1953.

R. LETACONNOUX.

Les Fonds de «Claire» des Environs de La Rochelle.

Des dosages de certains éléments entrant dans la composition des sols de claires ont été entrepris en 1953 sur des prélèvements provenant de la région ostréicole de La Rochelle (l'Aiguillon s/mer, Ile de Ré, Lauzières, Angoulins, Fouras). Ils ont porté jusqu'ici sur les teneurs en matière organique, carbonate de calcium, fer total, humus et phosphate, sur la granulométrie et sur le nombre global de bactéries. Les variations de la matière organique,

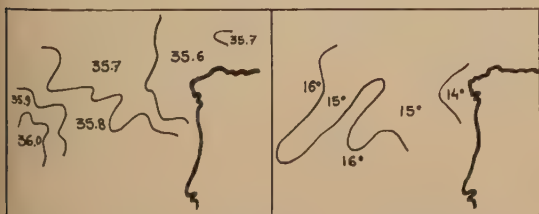


Figure 1. Salinité et température en surface, Juin 1954.

du phosphate et du nombre de bactéries ont été suivies à des intervalles les plus réguliers possibles, afin de mettre éventuellement en évidence une relation entre ces éléments et l'état de verdeur des claires, qui est due à la pullulation de la diatomée *Navicula ostrearia*.

Granulométrie. Elle est variable, et dépend d'une part des caractéristiques du sol dans lequel a été creusée la claire et d'autre part des apports ultérieurs de l'eau de mer introduite périodiquement. En général, en ce qui concerne les claires creusées dans le «bri», qui est une ancienne vase littorale exondée, la phase de diamètre supérieur à 0.044 mm. (tamis 325, série ASTM) ne représente pas plus de 7% du total. Dans les autres cas, qui sont moins fréquents, la phase grossière est constituée par du sable quartzeux (Ile de Ré) ou calcaire (Angoulins) selon les cas.

Carbonate de calcium. Toujours présent. Il varie de 18.6 à 5.6% (maximum et minimum observés). Les sols fins, où la phase argileuse est dominante, sont les moins riches en calcaires (de 5.6 à 8%).

Humus. Répartition et teneurs très irrégulières: de 1.8 à 10.1% (exprimé en humate de sodium). L'humus n'est apparu en relation avec aucun autre constituant, ni avec l'état de verdeur, ni avec l'époque de l'année.

Fer. Présent à la fois sous forme de sulfure, d'oxydes et de composés organiques. Les teneurs varient de 4.0 à 10.9%, et sont plus élevées dans les sols fins que dans les sols grossiers.

Matière organique. D'une manière générale, les sols les plus fins ont les teneurs les plus élevées: 12.7—13.8 à Lauzières, 9.7 à l'Ile de Ré, tandis que les sols où une phase sableuse est assez abondante ont les teneurs les plus faibles: 4.10 et 2.4 à Fouras (série de dosages effectuée en Février 1954).

Au cours de l'année 1954 des déterminations de la matière organique ont été faites régulièrement dans une claire de Lauzières: la teneur a décru de Mars (10.4%) à Mai-Juillet (vers 7.5%) pour remonter ensuite à la fin de l'année (9.4 en fin Octobre).

Il n'est pas apparu de relation nette entre richesse en matière organique et état de verdeur.

Nombre de bactéries. Des numérations effectuées à l'aide de cultures sur milieu de Reuszer ont été poursuivies en 1954 concurrentement aux dosages de matière organique (Lauzières). Les variations du nombre de bactéries ont suivi celles de la matière organique (maximum: 31×10^6 , minimum 4.2×10^6). D'autre part, des cultures comparées ont montré que les bactéries sont plus nombreuses dans les sols fins.

Phosphate. De nombreuses mesures ont mis en évidence la large variabilité du phosphate soluble (maximum observé 66.0 μg . par g. de sédiment, minimum: traces). Une série de dosages à de brefs intervalles a été conduite au mois de Février 1955 dans 4 claires de Lauzières: en 28 jours les teneurs moyennes sont passées de 25 μg . (1er jour) à 60 μg . (15 jours) pour redescendre à 32 μg . (28 jours) lorsque les mesures ont été interrompues. Pendant cette période les claires ont bien verdi, mais le verdissement diminuait considérablement dans les derniers jours. Une telle évolution concomitante de l'état de verdissement et de la teneur en phosphate semble permettre d'interpréter des observations isolées montrant des claires non-vertes très pauvres ou au contraire riches en phosphate: la pullulation des *Navicula* prendrait fin par épuisement du phosphate et ne pourrait se produire de nouveau qu'après une reconstitution plus ou moins complète et plus ou moins longue du stock de phosphate. Il a été constaté en effet que des claires où la verdeur vient de disparaître ont des teneurs en phosphate très faibles.

Des séries de dosages du phosphate en différents points de coupes verticales dans des fonds de claires ont été réalisées; elles ont montré que la teneur vers 8—10 cm. est généralement plus faible qu'en surface mais que vers 18—20 cm. elle est au contraire plus forte, souvent de 25 à 30% supérieure (ces séries de mesures ont été faites dans des claires assez riches en phosphate en surface). Cette observation peut être rapprochée du fait que les claires récemment recréusées ont tendance à verdifier rapidement et assez durablement.

JEAN G. LAFUSTE.

Plancton et Faune.

Scottish Investigations from Aberdeen.

Plankton observations by Scottish research vessels in the area of the Atlantic Committee in 1954 were confined to the August cruise of F.R.S. "Scotia" in the region off the west of Ireland and Rockall. At this time phytoplankton in the area west of Porcupine Bank largely consisted of dinoflagellates, especially the species *Ceratium fusus* and *C. tripos* with much dead *Rhizosolenia*, whilst between Porcupine Bank and the Irish coast a proportion of the *Rhizosolenia alata* and *Rh. shrubsolei* were still flourishing with abundant *Ceratium macroceros*. The zooplankton showed that west of Ireland, south of about 54°N. the 'Lusitanian' fauna was widespread in the sub-surface layers. In addition to the normally common species the following were of interest. The medusae *Cobolonema sericeum*, *Aeginura grimaldii*; the siphonophores *Sphaeronectes gracilis*, *Bassia bassensis*, *Nectopyramis thetis* and unusually abundant *Lensia fowleri*; the molluscs *Carinaria lamareckii*, *Peraclis reticulata* and *Clio polita*; the polychaetes *Vanadis formosa*, *Lagisca hubrecti*, *Nectochaeta caroli*, *Sagitella kowalewski*, *Tomopteris cavalli*; and the crustacea *Phronima sedentaria*, *Vibilia pyripes* and *V. gibbosa*, *Eucopia hanseni*, *Euphausia krohni*, *Stylocheiron longicorne* and *S. maxima*.

Further north, at about 57°N., this fauna was largely confined to the east side of Rockall and below about 250 m. where in addition to a representative series of the above Lusitanian species a specimen of the large diatom *Ethmodiscus gazellae* was also found. In 1953 this community was found both east and west

of Rockall. Surface waters in the area were not rich, and the surface plankton appeared to be of more westerly origin. The significance of the plankton from the area on the Scottish fisheries is discussed in the report to the Near Northern Seas Committee.

J. H. FRASER.

Recherches sur le Phytoplancton.

Le programme de recherches sur le phytoplancton portait, en 1954, sur le Bassin d'Arcachon (Lat. N. 44°40', Long. W. 3°30'). L'ostréiculture étant la principale richesse de cette région, on a recherché quel pouvait être le rôle de ce plancton dans la nourriture des huîtres (principalement chez *Gryphea angulata* LMK.)

Les variations du plancton ont été suivies méthodiquement dans l'ensemble du Bassin grâce à des prélèvements réguliers à raison d'un lot par semaine prélevé à une station fixe, chaque lot comprenant trois captures.

À côté de formes benthiques présentant une constance relative, les variations du phytoplancton du Bassin d'Arcachon traduisent fidèlement les influences hydrologiques qui s'y manifestent. Diatomées et péridiniens apparaissent et disparaissent se renouvelant continuellement et formant, à un moment donné, des associations caractéristiques de l'époque considérée.

La succession des espèces dans la flore planctonique du Bassin d'Arcachon semble liée aux mouvements des courants océaniques dans le Golfe de Gascogne.

S. LE ROUX.

LES POISSONS

Note Complémentaire sur le Merlu Noir:

(*Merluccius senegalensis* CADENAT).

Il nous a été donné, en 1954, d'étudier comparativement un lot de Merlus blancs provenant d'Agadir, (N: 164) un lot de Merlus noirs de même origine (N: 155) et un lot de Merlus noirs de Mauritanie (N: 73).

Nous donnons ici les éléments les plus caractéristiques des résultats obtenus.

I. Vertèbres.

Les Merlus blancs étudiés ont une moyenne vertébrale de 50.8 (mode: 51) qui correspond bien aux chiffres trouvés antérieurement pour les Merlus de Casablanca.

Chez les Merlus noirs d'Agadir la moyenne vertébrale est de 53.18 chiffre voisin de celui obtenu en 1952 chez les poissons de même origine (53.2), et de celui de 53.3 publié par LETACONNOUX en 1950 (Merlus de la région de Safi et du Rio de Oro).

Pour les Merlus noirs de Mauritanie, la moyenne de 53.83 (mode: 54) rejoint celle de DA FRANCA (53.82) et se rapproche de celle donnée par BELLOC en 1937 pour les Merlus de la presqu'île du Cap Vert (54.09).

II. Branchiospines.

Les Merlus blancs d'Agadir, possèdent 10 branchiospines en moyenne, par arc.

Chez les Merlus noirs d'Agadir la moyenne est de 14.4 environ (mode 14, nombre minimum pour les arcs droit et gauche: 24).

Les Merlus noirs de Mauritanie, de leur côté, ont une moyenne de 14.9 (mode 14—15; minimum pour les 2 arcs: 26).

Le mode de 14 est celui trouvé par LETACONNOUX sur les Merlus du Cap Cantin, tandis que la moyenne de 14.9 est proche de celle de DA FRANCA, 15.08 (Merlu de Mauritanie); cet

auteur n'a pas trouvé de Merlu noir ayant moins de 27 branchiospines sur les deux arcs.

III. Tache de la membrane branchiostégale.

Les observations faites peuvent se résumer de la façon suivante:

	Merlus blancs Agadir (N: 164)	Merlus noirs Agadir (N: 155)	Merlus noirs Mauritanie (N: 55)
Individus à:	%	%	%
Tache nulle	89.63	34.19	0.00
Tache peu marquée	10.37	52.26	5.45
Tache bien marquée	0.00	13.55	94.55
Total	100.00	100.00	100.00

Comme l'a signalé DA FRANCA, la tache de la membrane branchiostégale est un bon caractère pour distinguer le Merlu blanc (*M. merluccius* L.) du Merlu noir de Mauritanie.

Le Merlu noir marocain, au contraire, ne présente pas de différence de pigmentation aussi marquée avec le Merlu blanc.

Il est très important de signaler que ces caractères: nombre de vertèbres, nombre de branchiospines, présence ou absence de la tache branchiostégale sont indépendants les uns des autres: par exemple, un Merlu noir marocain à tache bien marquée peut avoir un nombre de vertèbres relativement bas (52 ou 53) et un nombre de branchiospines variant entre 14 et 17.

Nous conserverons le nom de *Merluccius senegalensis* CADENAT au Merlu noir marocain, ses caractères correspondant à ceux fixés par l'auteur.

L'hypothèse d'hybridation entre deux espèces dans la région où elles cohabitent n'est pas à exclure, mais les résultats obtenus sont encore insuffisants pour permettre de conclure à cette possibilité.

CL. MAURIN.

Gadoid Fish.

INTRODUCTION

Contribution to this report have been received from the following countries:—

Denmark:

J. S. JOENSEN
PAUL HANSEN

J. KNUDSEN

Germany:

J. LUNDBECK
J. MESSTORFF

ARNO MEYER

Iceland:

JÓN JÓNSSON

ÁRNI FRÍÐRIKSSON

Norway:

ALF DANNEVIG
G. ROLLEFSEN

STEINAR OLSEN
G. SÆTERS DAL

Scotland:

R. JONES

W. MAIN

GUNNAR ROLLEFSEN.

The numerous contributions to the Gadoid Fish Committee in this volume of the *Annales Biologiques* prove that the steps taken towards the establishment of a subject committee on gadoid fish were right.

Among the species of demersal fish the gadoid group is the most important to mankind and it is also this group that should be given the closest attention of fisheries science and fisheries policy. Now that all the different species belonging to the Gadidae can be considered at one and the same time it will be easier to solve problems and compare results regarding these fish. It is to be hoped that in the years to come the Gadoid Fish Committee will contribute to the work of the ICES in a successful way.

YOUNG STAGES

Faroes.

Fishing with stramin nets for pelagic fish larvae in the Faroe area was carried out by the "Dana" in June 1953 and 1954, in 1953 mainly between the 10. and the 14. June, and in 1954 mainly between the 15. and the 23. Samples were collected on 23 stations in 1953 and on 21 stations in 1954 (Tables 1 and 2, Figures 1 and 2).

Table 1. Larval Cod, Haddock, Whiting and Saithe. June 1953.

Total catch on 23 stations ¹).				
Length (mm.)	Cod	Haddock	Whiting	Saithe
< 5	1	3	4	—
5—9	290	1421	244	1
10—14	594	1931	95	2
15—19	328	429	12	6
20—24	148	102	1	4
25—29	32	44	—	5
30—34	—	15	—	2
35—39	1	7	—	1
Total number	1394	5640 ²	356	21
Number per hour	70	282	18	1.1
Average length	13.7	11.8	9.1	21.6

¹) On most stations two oblique hauls of 3 × 10 minutes each were made with 2 m. stramin nets (100—50—25 and 200—150—125 m. of wire out). In a few cases only the haul with 100—50—25 m. wire out was made.

²) Including 1688 specimens not measured.

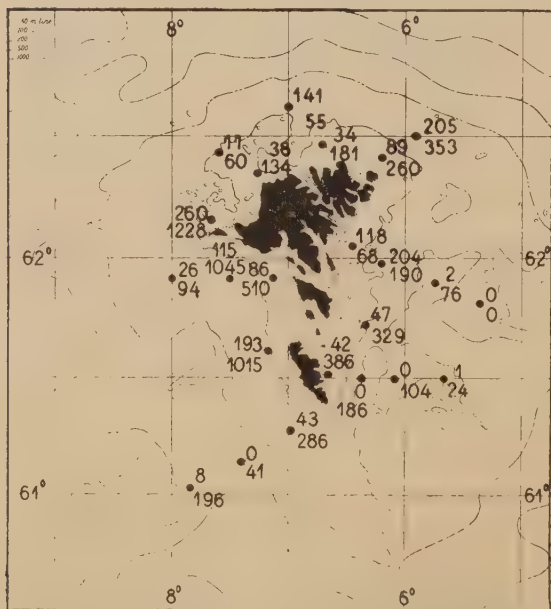


Figure 1. Numbers of larval cod (figure above) and haddock (figure below) per hour's haul with 2 m. stramin net. June 1953.

Compared with similar investigations in this area at the same time in previous years, the average lengths of the cod and haddock larvae were normal in 1953, and in 1954 greater than normal. The numbers of cod caught per hour were low in 1953, while the numbers of haddock were normal compared with the previous years. The numbers of cod and haddock caught per hour were very low in 1954. (In post-war years the average numbers per hour were 196 cod and 324 haddock).

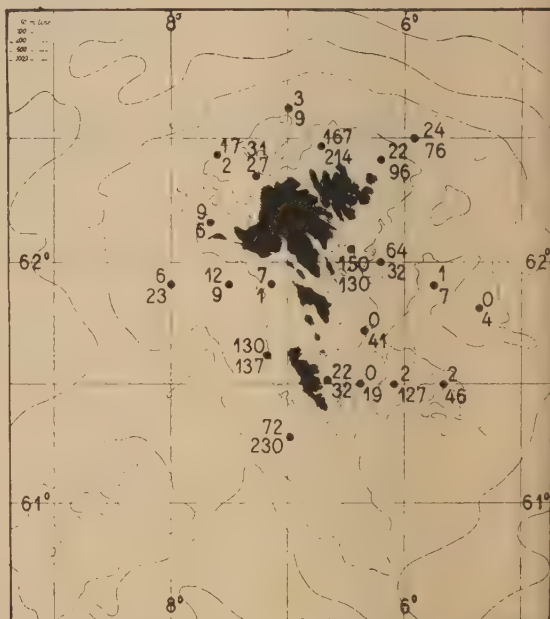


Figure 2. Numbers of larval cod (above) and haddock (below) per hour's haul with 2 m. stramin net. June 1954.

Table 2. Larval Cod, Haddock, Whiting and Saithe. June 1954.

Total catch on 21 stations.				
Length (mm.)	Cod	Haddock	Whiting	Saithe
5—9	16	83	8	—
10—14	175	524	12	5
15—19	265	316	11	6
20—24	132	146	5	11
25—29	50	99	—	8
30—34	11	30	—	4
35—39	3	13	—	1
40—44	—	3	—	—
45—49	—	3	—	2
Total number	652	1217	36	37
Number per hour	33	61	1.8	1.9
Average length	18.1	16.7	14.7	23.9

Norwegian Skagerak Coast¹⁾.

The usual experimental fishing in the littoral region in September and October gave the following average numbers per haul of the 0-group and I-group:—

The fjords between Kragerø and Mandal.

70—75 hauls.

	Cod		Whiting	Pollack
	0-group	I-group ²⁾	0-group	0-group
1917—29	20.1	2.2	14.9	23.1
1930—39	7.2	1.1	16.3	8.3
1940—49 ³⁾	4.7	1.0	29.6	8.8
1950	4.2	0.9	19.1	3.0
1951	1.9	1.2	18.2	2.6
1952	8.1	0.2	26.2	4.1
1953	14.7	2.9	12.4	2.6
1954	9.7	2.6	17.7	6.7

In 1954 the 0-group was relatively numerous.

The fjords near Langesund.

One of the fjords, the Frierfjord, was omitted, and 11 hauls were made in 1954.

	Cod		Whiting	Pollack
	0-group	I-group	0-group	0-group
1953 11 hauls	49.1	8.0	35.9	2.1
1954 —	51.7	4.8	9.2	3.7

The Langesund district gave a high number of 0-group cod.

The Oslofjord outside Drøbak.

The number of cod of the 0-group is moderate in 1954.

	Cod		Whiting	Pollack
	0-group	I-group ²⁾	0-group	0-group
1936—39	50.2	2.9	9.6	4.5
1940—49 ³⁾	33.5	2.5	38.0	6.7
1950	14.2	3.0	16.7	3.2
1951	3.9	1.3	6.1	2.6
1952	16.8	0.9	31.2	5.5
1953	16.9	2.6	10.3	1.3
1954	9.2	5.4	7.3	3.5

The inner Oslofjord.

The cod here is becoming very scarce, and so are the whiting and pollack.

	Cod		Whiting	Pollack
	0-group	I-group ²⁾	0-group	0-group
1936—39	14.3	2.1	5.8	3.8
1940—49 ³⁾	2.6	2.8	7.4	0.7
1950	0.04	0.2	1.0	0.1
1951	0.0	0.0	1.5	0.7
1952	0.0	0.0	0.6	1.7
1953	0.0	0.0	0.2	0.6
1954	0.17	0.08	0.1	2.3

¹⁾ The material from older years has been revised and some small corrections have been made.

²⁾ A few older specimens may be included.

³⁾ The series are incomplete during the war. The few hauls made in 1940—44 are not included.

Experimental fishing with traps for the older cod at Flødevigen resulted in 115 cod per trap, a relatively high number, mostly 1952 and 1953 year-classes.

Average	Cod per trap
1921—29	70
1930—39	63
1940—49	91
1950	101
1951	87
1952	85
1953	80
1954	115

This year a small number of cod larvae were liberated near Arendal.

ALF DANNEVIG.

Danish Waters.

Hauls with the 2 m. ring-trawl were carried out from S/S "Biologen" in May and June in Kattegat and the Belts, and the 1 m. ring-net was used in the Sound from M/B "Havkatten" in June.

The numbers of cod larvae caught per hour's fishing in May totalled 12 in the S. Kattegat and 65 in the Belts (2 and 9 hauls respectively). This number is much smaller than that of 1953, but is still well above the average for the period 1923—39.

The hauls in June showed that whiting larvae were found both in the Kattegat and in the N. Belt Sea. No larvae were found until 11. June. Considering the hauls after that date the following numbers were obtained per hour's fishing: Kattegat 30 (18 hauls), Belts 10.5 (8 hauls).

It is of some interest to note that pollack larvae were found in several hauls in June both in the Kattegat and the N. Belt Sea.

Kattegat.

Cod. In the following summary, giving the number of cod per hour's haul with the cod trawl from S/S "Biologen", only the hauls made later than 1. July have been considered. The 0-group cod do not appear in the catches before that time:—

	No. of hauls	No. per hour
N. Kattegat	9	45
S. Kattegat	10	45

In previous years most of the experimental fishing has been carried out by the much less effective gear, the eel-tog. A comparison between the efficiency of the two gears has shown

that the efficiency of the cod trawl is roughly 3 times that of the eel-tog. If this factor is used the experimental fishing in 1954 shows that the stock of cod in the N. Kattegat was nearly the same or only a little less than in the previous year and considerably below the average value for the period 1930—39. In the S. Kattegat, also, the stock was below that of 1953 and of the average for 1930—39.

These results are mainly due to the fact that 0-group fish were much less abundant than in the previous year. As in previous years the older age-groups (III-gr. and older) occur in very small numbers.

Whiting. In hauls from S/S "Biologen" with the cod trawl whiting appeared in small quantities only during the investigations in June and August. During the latter part of the summer, however, a considerable invasion of juvenile whiting took place. The number of whiting per hour's haul are shown below:—

	June	August	October	November
No. hauls	3	7	4	8
No. per 1 hour	67	34	303	1146

The whiting consisted almost exclusively of young fish, the 0-group forming about 90% of the stock during the autumn, individuals of the II-group and older being scarce.

Belts.

Cod. The following summary gives the number of cod obtained from hauls with the cod trawl from S/S "Biologen". It should be noted that only hauls taken after 1. July have been considered. The 0-group cod do not appear in the catches before that time.

	No. of hauls	No. per hour
Sound.....	6	308
N. Belts...	21	41
S. Belts....	40	227
W. Baltic..	20	164

In all areas the number of cod is above the average value for the period 1930—39 (the efficiency of the cod trawl being roughly 3 times that of the hitherto used eel-tog, as shown by means of comparative hauls). Compared with 1953 the quantity was, however, much smaller, which is due to the enormous number of 0-group cod of that year compared to 1954.

The 0-group cod formed in most hauls the majority of the catches, particularly in the Little Belt and the W. Baltic; one haul yielded about 400 0-gr. per hour's fishing. Older cod (III-gr. and older) were scarce, as in previous years.

Whiting. The hauls taken from S/S "Biologen" with the cod trawl indicated that a considerable influx of whiting took place during the latter part of the summer. This can be seen from the following summary which gives the numbers per hour's fishing:—

		June	Aug.	Oct.	Nov.	Dec.
Belts.....	No. hauls....	3	23	9	15	16
	No./hour....	119	24	156	375	148
W. Baltic	No. hauls....	—	11	6	3	
	No./hour....	—	18	276	247	

The whiting examined consisted almost entirely of young fish, in late summer and autumn the catches contained more than 90% of the 0-group. Specimens of group II and older were very scarce.

J. KNUDSEN.

COMMERCIAL FISH

COD

Greenland Stock.¹⁾**The Age Distribution of Icelandic trawler-caught Cod on Store Hellefiske Bank in 1954.**

The age-distribution data of Greenland cod presented here, covers three fishing areas on the Store Hellefiske Bank: the southern part, the middle of the bank and the northern part.

The material was collected on board the Icelandic trawler "Thorkell Máni" under the supervision of its captain, Mr. HALLGRÍMUR GUÐMUNDSSON.

The table below gives the average position of the fishing grounds in question, together with the age distribution of the samples.

Age	7/8	9-11/8	16/8	Total
	66°49'N. 54°45'W.	67°22'N. 55°24'W.	67°50'N. 54°20'W.	
4.....	2.2	3.4	1.7	2.5
5.....	4.0	2.2	1.3	2.5
6.....	23.5	15.9	13.8	17.8
7.....	54.7	61.4	69.6	61.5
8.....	5.4	7.1	5.8	6.2
9.....	5.8	4.7	5.4	5.3
10.....	1.4	1.2	0.4	1.1
11.....	0.4	0.3	0.8	0.5
12.....	2.5	3.1	1.3	2.4
13.....	—	0.3	—	0.1
14.....	—	—	—	—
15.....	—	0.3	—	0.1
Total.....	276	321	240	837

There is a rather peculiar rise in the percentage of the 1947 year-class as we advance north. We also found the same thing in the material from 1952 where the 1947 year-class was more abundant on the northern banks, constituting 63.3% of the catches on Store Hellefiske Bank, compared with 44.5% on the Fylla Bank.

The small numbers of the 1945 year-class is very conspicuous. In 1953 it constituted 36% of the trawler catches on Fylla Bank, but this year it only amounted to 5.3% on the Store Hellefiske Bank. We do not know whether this year-class has migrated southwards or to the waters off the bank. In our 1953 material the largest part of it had reached maturity so the absence from the bank might be the result of a new phase in its biology.

JÓN JÓNSSON.

German Investigations.

During the 1954 Greenland season German trawlers carried out 8 trips (2 for salting in May and June and 6 for fresh fish from August till the end of February). Whilst salting was done on the banks from Dana to Fylla, the fresh-fish trawlers were fishing mostly with good result in the area of Cape Farewell to Cape Desolation and later, when ice covered the southern trawling grounds, at Dana Bank. In the SW. area the 1945 and 1947 year-classes are predominant. But compared with the two preceding years the 1945 year-class has become very weak; most of them seem to have migrated for spawning to Iceland. Thus, at present, the fishery, even in the SW. of Greenland, depends more and more on the 1947 year-class, which has grown very slowly. At the end of February 1955 the 1947-cod had an average length of 66.3 cm. and an average weight (gutted) of 2.4 kg.

Table 3. Length and Age Composition of German Cod Landings from the 1954/55 Greenland Season. (°/00).

Lengths (cm.)	Dana Bank end of May	SW. coast August	Dana Bank end of Febr. 55
40—44.....	—	2	—
45—49.....	—	24	—
50—54.....	—	98	23
55—59.....	—	89	85
60—64.....	—	217	356
65—69.....	—	145	309
70—74.....	—	159	126
75—79.....	—	119	38
80—84.....	—	96	46
85—89.....	—	44	15
90—94.....	—	6	1
95—99.....	—	1	1

Age	Year-class			
4	1950	—	4	44
5	1949	25	143	81
6	1948	20	10	148
7	1947	590	360	554
8	1946	23	22	31
9	1945	186	404	57
10	1944	9	4	13
11	1943	14	4	1
12	1942	120	18	62
> 12	before 1942	13	31	9

ARNO MEYER.

¹⁾ See also Appendix on p. 20.

Iceland Stock.

The Spawning Stock in 1954.

Table 4 gives the age composition of the spawning stock in 1954. The table is calculated in 10,000 and is based upon the age determinations of 2937 mature cod caught on longlines off the south and south-west coasts of Iceland during the months January-May.

There is a great dominance of the 1945 year-class, and it constituted a greater part of the stock in 1954 than we expected. This is mainly caused by a later onset of maturity than normal (there are 4913 first-time spawners as nine-year-olds, against the normal 1069 out of ten thousand). The apparent increase in age of first-time spawners might also be the result of the closure in 1950 of some very important nursery grounds off the north coast. The year-class in question has been given protection until it has reached maturity and entered the main fishery for cod, which is carried out off the south and south-west coast during the spawning season January-May¹⁾.

The prediction of the output of the fishery in 1954 gave a very satisfactory result.

Table 4. The Composition of the Spawning Stock of Cod in 1954.

Age-Group	Age at first spawning														Total
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
IV	44	—	—	—	—	—	—	—	—	—	—	—	—	—	44
V	—	323	—	—	—	—	—	—	—	—	—	—	—	—	323
VI	7	7	269	—	—	—	—	—	—	—	—	—	—	—	283
VII	—	3	44	340	—	—	—	—	—	—	—	—	—	—	387
VIII	—	—	—	65	157	—	—	—	—	—	—	—	—	—	222
IX	—	3	3	78	991	4913	—	—	—	—	—	—	—	—	5988
X	—	—	—	27	75	422	473	—	—	—	—	—	—	—	997
XI	—	—	—	17	51	123	395	160	—	—	—	—	—	—	746
XII	—	—	3	27	157	189	170	197	14	—	—	—	—	—	752
XIII	—	—	—	3	10	14	7	7	—	—	—	—	—	—	41
XIV	—	—	—	—	7	7	3	—	—	—	—	—	—	—	17
XV	—	—	3	3	7	7	7	0	3	—	—	—	—	—	30
XVI	—	—	—	—	—	3	3	—	—	—	—	—	—	—	6
XVII	—	—	—	3	14	24	17	10	7	—	3	78	—	—	78
XVIII	—	—	—	3	7	3	14	14	3	—	—	44	—	—	44
XIX	—	—	—	3	7	14	3	3	—	—	—	30	—	—	30
XX	—	—	—	—	—	7	—	—	—	—	—	7	—	—	7
Total	No.	51	336	349	569	1483	5721	1092	391	27	—	3	9995	—	

Spawning classes														Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
6693	2121	463	278	194	58	36	41	44	23	24	17	3	—	9995

JÓN JÓNSSON.

¹⁾ It is a well known fact that the cod reaches maturity at a later age off the north coast than in the warm waters off the south coast.

German Observations.

The German catch of cod amounted in 1954 to 36,500 tons, mostly caught in the SW. (February—May) and NW. area (May—December). Compared with 1953 the cod on the spawning places in the SW. showed a remarkable increase in average length. Age determinations showed the extraordinary dominance of

Table 5. Length and Age Composition of German Cod Landings from SW., NW., and E. Iceland in 1953 and 1954. (‰).

Length cm.	SW. coast		NW. coast		E. coast
	1953	1954	1953	1954	1954
40—44	—	—	1	2	1
45—49	—	—	11	12	10
50—54	—	2	34	34	26
55—59	—	1	61	65	60
60—64	21	5	91	88	134
65—69	86	34	119	105	215
70—74	243	126	160	171	164
75—79	242	260	204	183	92
80—84	168	281	155	172	109
85—89	83	170	88	106	75
90—94	71	74	42	53	55
95—99	46	29	21	20	28
100—104	18	12	8	9	11
105—109	11	6	2	4	10
110—114	3	—	2	1	6
115—119	—	—	1	2	3
120—124	4	—	—	—	1
Age	Year-class				
	1951	—	—	23	—
4	1950	—	—	121	85
5	1949	9	—	167	415
6	1948	12	—	57	121
7	1947	42	—	30	125
8	1946	5	—	9	17
9	1945	818	—	528	192
10	1944	21	—	17	14
11	1943	32	—	10	8
12	1942	61	—	34	22
> 12	before 1942	—	—	4	1

the 1945 year-class (818‰ at the spawning places and 528‰ at the feeding grounds of the NW.). Combined age- and weight-examinations revealed that 25,000 tons, that is 69‰ of the total German catch, consisted of cod of this 1945 year-class, a great part of which seems to have grown up in S. and SW. Greenland waters. The 1949 year-class too is a rich one and was in 1954, for the first time, of commercial value (2,700 tons = 7.5‰). The rich 1942 year-class has become very weak, but its share amounted still to 2,300 tons (6.5‰). The average length of the two most important year-classes were 69 cm. (1949) and 82 cm. (1945).

ARNO MEYER.

Table 6. Age and Length Composition of the German Landings of Cod from the North-Eastern Fishing Grounds. (°/00).

Age-Group	Area	Norw. Coast	Bear Isl. Deep	Finn-mark	Barents Sea	Length-Groups	Norw. Coast	Bear Isl. Deep	Finn-mark	Barents Sea
	Month	Feb.-May	May	May	Oct.-Dec.	cm.	Feb.-May	May	May	Oct.-Dec.
II (1952)	—	—	—	—	—	40—44	0	1	0	—
III (1951)	—	—	—	—	7	45—49	1	9	24	6
IV (1950)	2	34	—	—	156	50—54	6	14	109	67
V (1949)	19	63	—	—	254	55—59	27	48	140	201
VI (1948)	149	618	—	—	447	60—64	87	159	126	238
VII (1947)	198	139	—	—	96	65—69	147	316	136	183
VIII (1946)	133	48	—	—	34	70—74	155	204	125	119
IX (1945)	134	44	—	—	5	75—79	149	88	143	86
X (1944)	116	32	—	—	1	80—84	138	49	71	58
XI (1943)	85	16	—	—	—	85—89	107	57	56	25
XII (1942)	64	4	—	—	—	90—94	77	31	30	11
XIII (1941)	41	1	—	—	—	95—99	55	13	17	4
XIV (1940)	28	—	—	—	—	100—104	31	6	13	2
XV+	31	1	—	—	—	105—109	12	4	7	0
						110—114	5	1	2	0
						115—119	2	—	—	—
						120+	1	—	1	—
						Mean length				
						cm.	79.0	71.2	69.6	66.3
						Mean weight				
						g.	3370	2199	2195	1959

Arcto-Norwegian Stock.**German Landings.**

With a very slight decrease in average length, the landings from the NW. Norwegian fishing area showed a clear predominance of the 1947 year-class, which in the previous year was already relatively strong. In spite of a distinct decrease the 1945 year-class, which was the strongest in the previous year, still exceeded the 1946-class. The average catch per fishing day has fallen from 2.8 tons in 1953 to 2.3 in 1954 and it also fell in the spring monthly maximum from 4.4—6.1 tons in 1953 to 2.7—3.4 tons in 1954. The 1948 year-class which had, until now, only been predominant in the Bear Island area, was by far the strongest in the Barents Sea catches. The average length has decreased accordingly. The comparative average daily catches in the last

quarter of the year rose from 8.2 to 12—16 tons in the central part of the Barents Sea.

J. LUNDBECK.

The Stock of "Skrei".

The yield of the Lofoten fishery in the years 1953 and 1954 was unusually low: 49,000 tons and 42,000 tons compared with an average of 96,000 tons in the period 1946/52. This is mainly ascribed to the low state of the stock, the 1940, 1941, 1944 and 1945 year-classes being extremely poor while those from 1942, 1943 and 1946 are of medium strength. A significant rise in the stock of skrei is not expected until 1956 or 1957.

Figure 3 shows the age distributions of male and female fish in longline samples from the Lofoten seasons 1953 and 1954 and the deviations from the average distributions 1932/51.

G. ROLLEFSEN.

Faroe Stock.**Spawning Cod North of the Faroes.**

Figures 4 and 5 show the age distribution of the spawning cod north of the Faroes in 1954 compared with the previous years. In 1954 837 cod otoliths were collected from the commercial longline fishery north of the islands. The 1947 year-class has been particularly good in 1952 and 1953, comprising about 40%, but in 1954 it was reduced to 20%. 2865 spawning

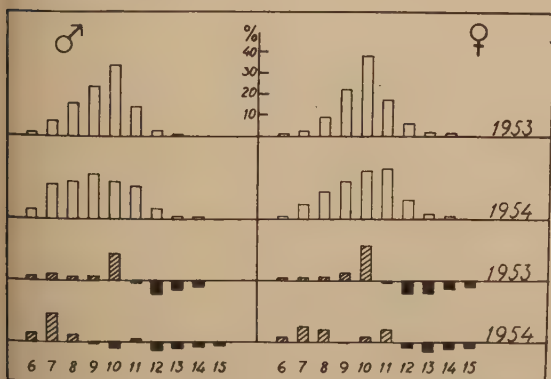


Figure 3. Percentage age distribution of cod, Lofoten, longlines, and deviations from average 1932/51.

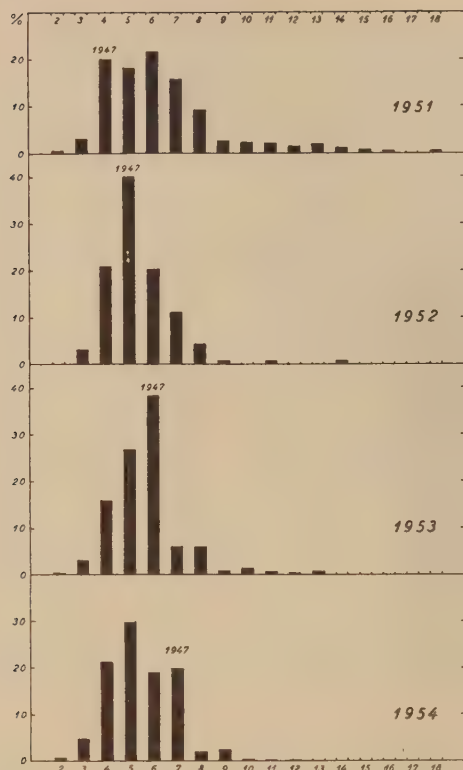


Figure 4. Age composition of spawning cod, north of the Faroes.

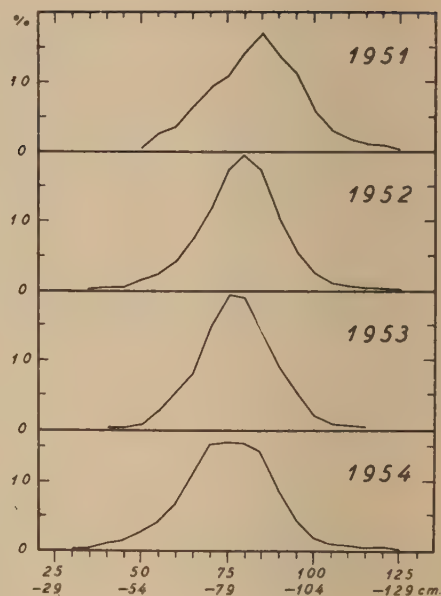


Figure 5. Length distribution of spawning cod, north of the Faroes.

cod from the commercial longline fishery were measured in 1954, and Figure 5 shows the length distribution in 1954 compared with previous years.

J. S. JOENSEN.

HADDOCK

Arcto-Norwegian Stock.

Table 7. Age and Length Composition of the German Landings of Haddock from the North-Eastern Fishing Grounds. ($^{\circ}/_{00}$).

(Age determinations by Dr. SAHRHAGE and Dr. SEEMANN.)

Age-Group	Norw. Coast Febr.-May	Barents Sea Oct.-Dec.	Length-Groups cm.	Norw. Coast Febr.-May	Barents Sea Oct.-Dec.
II (1952)	—	1	30—34	1	1
III (1951)	—	53	35—39	6	37
IV (1950)	33	600	40—44	16	343
V (1949)	135	127	45—49	41	292
VI (1948)	554	184	50—54	272	101
VII (1947)	153	11	55—59	410	116
VIII (1946)	58	5	60—64	163	64
IX (1945)	35	6	65—69	58	21
X (1944)	15	5	70—74	18	9
XI (1943)	7	3	75—79	9	8
XII (1942)	4	2	80—84	5	6
XIII (1941)	3	3	85—89	1	2
XIV (1940)	2	—		0	0
XV+	1	—			
			Mean length cm.	57.3	
			Mean weight g.	925	

German Landings.

The very strong 1948 year-class continued to predominate in the catches from north-western Norway and was obviously the cause of an increase in the average daily catch from 1.1 ton in 1953 to 2.3 tons in 1954, in March alone the catch increased from 3.3 tons in 1953 to 6.8 tons in 1954. However, the same year-class in the Barents Sea is now far exceeded by the younger one of 1950, as a result of which the average length of the haddock landed decreased and the daily catch rose from an average of 2.2 tons in 1953 to 3.1 tons in 1954. (See Table 7).

J. LUNDBECK.

Age Distribution and Migration.

Age distribution.

Since 1950 sampling has been carried out in the two most important fishing areas of this population, the Finnmarken coast and the Norwegian coast from Röst to Malangen. In the latter district the fishery is based on the migrating mature part of the stock, and accordingly takes place in the months February to April only.

Figure 6 shows the age distributions in the years since 1950. In Finnmark, samples have been obtained from both trawl and longlines. Since 1952 the 1948 and 1950 year-classes dominate the samples. The high absolute strength of these outstanding year-classes is shown by the unusually high yield of the Norwegian haddock fishery in Finnmark in 1953 and 1954; in both these years a record catch of 24,000 tons was taken compared to an annual catch of 11,000 tons in the 1930—39 period and 14,000 tons in the 1948—52 period.

On Goose Bank in the eastern Barents Sea a

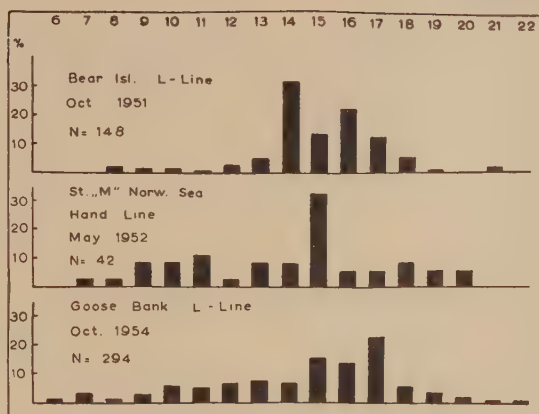


Figure 7. Percentage age distributions of some samples of old haddock.

new longline fishery for haddock has taken place in the autumn in both 1953 and 1954. The fish was reported to be unusually large, and in 1954 an otolith sample was obtained and 172 fish were marked. In Figure 7 the age distribution of this and two other samples of very old haddock is shown. It is interesting to note that the 1937 year-class dominates the age distributions in each of these samples from widely different localities. It is difficult to explain the existence of these sub-populations of very old fish since both the marking experiments and the age analysis of the spawning stock suggest a rather high mortality and a rapid decline of the year-classes after the sixth year. These old fish are apparently under-exploited. It is perhaps more than a coincidence that the dominating year-classes seem to be those which passed the normally high exploited age period of 4 to 7 years during the war years of protection.

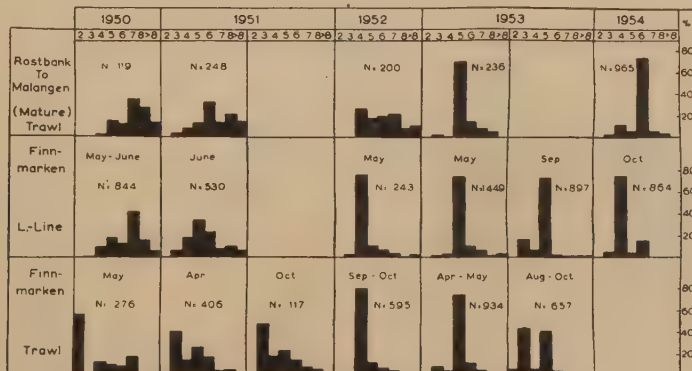


Figure 6. Percentage age distribution of haddock.

Marking experiments.

Since November 1952 a total of 1826 marked haddock have been released. Table 8 shows the experiments in which 10 or more fish were released.

In experiments Nos. 11, 14, 30, 31 and 32 the fish used were caught on longlines. In all the other cases trawl-caught fish have been used.

Lea tags fastened with nylon in the neck were used in all experiments. The visibility of the Lea tags fastened in this way does not seem to be very good, as in many cases the fish has passed three to five hands before the tag was observed. In some of the latest experiments coloured nylon has been used in an attempt to increase the visibility.

Table 9 shows the returns in each month from the experiments Nos. 1 and 11. The

Table 8. Haddock Marking Experiments. Returns up to 20. April 1955.

Exp. no.	Locality	Date	N	Returns
1	Finnmark	Nov. 52	399	80
8	Spitsbergen	Sept. 53	35	0
11	Finnmark	—	397	44
12	Senja banks	Mar. 54	10	1
14	Fugløy	—	22	0
16	Finnmark	—	24	2
18	E. Barents Sea	—	44	0
19	Thor Iversenbank	—	82	2
21	Röst bank	Apr. —	16	0
22	E. Barents Sea	Oct. —	10	0
24	Finnmark	—	46	2
25	East Bank	—	32	2
28	Finnmark	—	35	2
29	—	—	11	0
30	Goose Bank	Sept. —	83	1
31	—	Oct. —	89	4
32	Finnmark	—	253	7
33	Andøy	Feb. 55	24	0
34	E. Barents Sea	Mar. —	10	0
35	Malangen Bank	—	154	1



**Table 9. Experiments Nos. 1 and 11. Haddock released on the E. Finnmark Coast.
Returns up to 20. April 1955.**

	Exper. 1, 399 haddock released 4.—11. Nov. 1952				Exper. 11, 397 haddock released 28. Aug.—26. Sept. 1953.		
	1952	1953	1954	1955	1953	1954	1955
January.....	—	4	1	—	—	2	1
February.....	—	1	5	1	—	—	1
March.....	—	6	9	1	—	2	3
April.....	—	2	1	—	—	2	—
May.....	—	9	—	—	—	4	—
June.....	—	5	—	—	—	—	—
July.....	—	3	—	—	—	2	—
August.....	—	6	—	—	—	2	—
September.....	—	6	—	—	6	—	—
October.....	—	10	3	—	10	1	—
November.....	1	1	—	—	4	—	—
December.....	1	2	—	—	2	—	—
No inform.....	—	—	—	2	—	—	2
Total.....	80				44		
% returns.....	20.1				11.1		

Release of 1952
returned from:
Norway... 44
England... 16
Germany... 15
Russia... 2
France... 3

Release of 1953
returned from:
Norway... 27
England... 11
Germany... 5
Russia... 1

Total..... 80

Total..... 44

positions of the long-distance returns in these experiments is illustrated in Figure 8. In the first quarter of the year most of the recaptures have been made on the Norwegian coastal Banks from Röst to Malangsgrunnen showing the spawning migration or at least a part of it. The two southernmost returns, near Röst are also the latest ones in this area, dated 30.

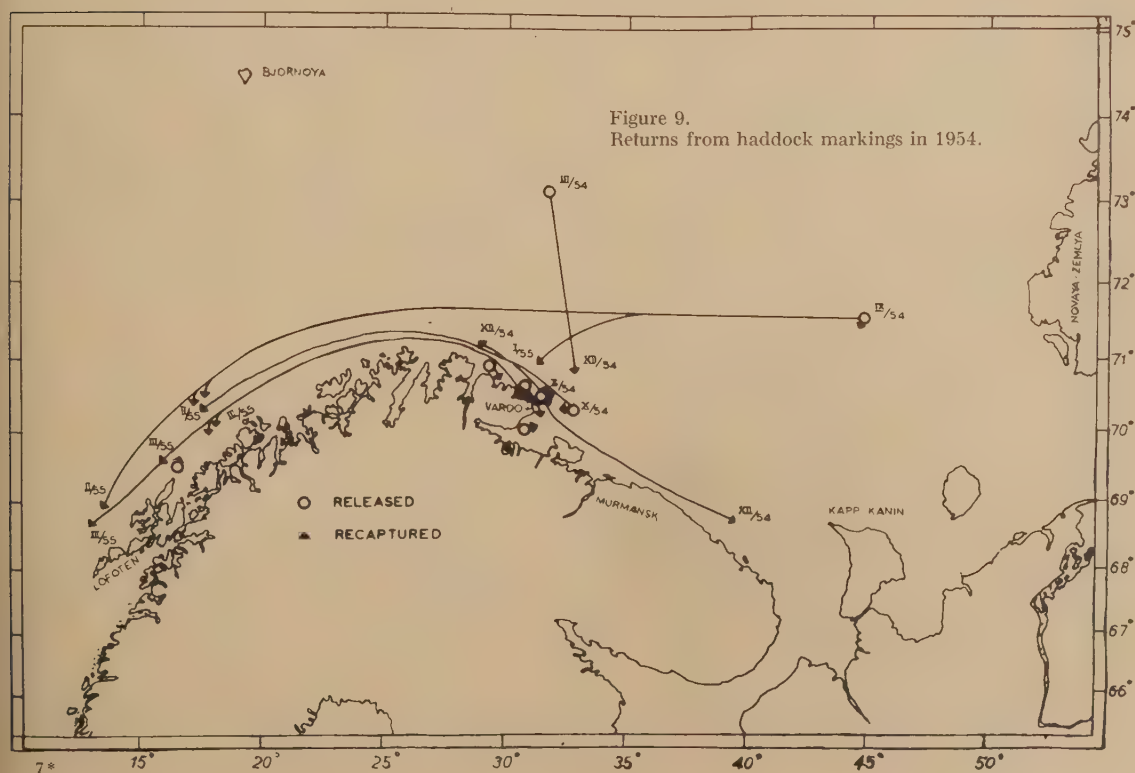


Figure 9.
Returns from haddock markings in 1954.

March and 9. April 1954. Most of the returns to the east of the tagging localities have been made in summer and autumn. More data are needed to show the regular migrations in this area.

Figure 9 shows the preliminary results of the haddock taggings carried out in 1954. The farthest wandering is shown by a haddock of 78 cm. length, released on Goose Bank on 23. September 1954 and recaptured off Anda

on the Norwegian coast on 26. February 1955. The minimum distance is about 660 n. miles.

The results of these experiments indicate that the haddock in the Barents Sea and Svalbard areas constitute one main population, the mature part of which undertake spawning migrations to the Norwegian coast in the spring. There is, however, still some doubt as to the exact location of this spawning ground.

G. SÆTERSDAL.

Table 10. Aberdeen Trawlers' Market Samples - Faroe Haddock - 1954.

A. Number landed/10 hrs. Fishing.										
Brood	Jan.	Febr.	Mar.	Apr.	May	June	July	Aug.	Sept.	Dec. ²⁾
1953.....	—	—	—	—	—	2.1	—	—	17.9	171.6
1952.....	—	599.7	33.9	—	286.4	996.7	888.6	790.2	524.1	808.3
1951.....	680.6	317.1	367.0	280.7	291.5	320.4	381.3	362.8	181.1	136.1
1950.....	181.4	105.9	134.0	186.0	195.4	75.4	102.6	110.1	69.1	23.3
1949.....	107.0	30.5	55.6	92.0	149.4	26.8	39.6	48.9	41.7	4.9
1948.....	30.0	16.1	42.4	34.2	80.1	22.2	27.9	24.2	22.4	2.6
1947.....	8.4	6.8	4.2	5.2	4.6	7.9	11.9	10.0	6.0	0.8
1946.....	2.8	0.9	1.3	6.2	0.9	1.2	1.8	1.3	0.6	0.2
1945.....	22.4	6.1	4.8	6.7	16.2	18.6	21.1	10.4	22.2	1.2
1944.....	5.6	4.3	4.4	2.0	8.3	10.5	21.0	8.6	7.5	0.7
1943.....	5.6	0.2	2.8	3.7	3.8	2.8	5.1	0.4	1.1	0.2
1942.....	—	0.9	—	0.6	—	0.9	1.4	0.8	—	—
1941+.....	—	0.03	0.2	1.1	0.5	0.2	—	—	—	—
Total.....	1043.8	1088.5	650.6	618.4	1037.1	1485.7	1502.3	1367.7	893.7	1149.9
B. Mean Lengths of each Age-Group sampled.										
1953.....	—	—	—	—	—	30.50	—	—	32.14	33.41
1952.....	—	33.48	32.65	—	34.35	35.84	34.47	35.17	37.18	40.92
1951.....	40.4	40.92	41.41	40.66	41.88	42.96	42.08	42.61	45.30	49.18
1950.....	46.8	49.61	49.21	48.36	49.18	50.75	48.07	49.40	51.50	53.27
1949.....	52.8	55.23	55.44	54.16	54.73	56.29	53.92	55.89	57.05	60.10
1948.....	59.3	60.90	60.17	58.37	60.10	61.77	60.21	60.80	60.96	64.84
1947.....	61.3	63.61	63.01	62.82	62.81	63.65	63.02	63.07	62.16	67.53
1946.....	64.0	62.61	66.62	63.71	65.00	63.33	63.00	65.25	64.00	81.00
1945.....	69.4	64.34	63.78	64.82	65.96	67.00	65.94	68.14	67.27	69.26
1944.....	69.5	68.09	69.50	69.28	71.22	69.99	69.86	67.00	69.13	70.64
1943.....	66.5	73.34	68.75	71.42	69.50	69.80	75.16	74.00	70.50	69.00
1942.....	—	70.00	—	80.75	—	71.33	72.00	67.00	—	—
1941.....	—	76.00	83.00	—	78.00	78.00	—	—	—	—
C. Estimated Weights ¹⁾ landed/10 hrs. Fishing (in cwt.).										
1953.....	—	—	—	—	—	0.0	—	—	0.10	1.07
1952.....	—	3.64	0.18	—	1.83	7.36	6.00	5.74	4.50	9.47
1951.....	7.46	3.43	3.90	2.96	3.47	4.26	4.79	4.76	2.85	2.80
1950.....	3.07	2.15	2.40	3.28	3.67	1.65	1.94	2.28	1.63	0.66
1949.....	2.79	0.84	1.39	2.30	3.91	0.69	1.05	1.40	1.34	0.19
1948.....	1.11	0.65	1.42	1.11	2.88	0.85	1.06	0.96	0.87	0.12
1947.....	0.34	0.28	0.16	0.21	0.19	0.34	0.51	0.43	0.25	0.04
1946.....	0.13	0.02	0.06	0.27	0.04	0.05	0.08	0.06	0.03	0.01
1945.....	1.15	0.25	0.19	0.30	0.75	0.93	1.04	0.58	1.09	0.07
1944.....	0.29	0.22	0.21	0.12	0.49	0.64	1.20	0.44	0.43	0.04
1943.....	0.30	0.01	0.14	0.22	0.20	0.17	0.32	0.02	0.06	0.01
1942+.....	—	0.05	—	0.12	0.03	0.07	0.08	0.04	—	—
Total.....	16.64	11.54	10.05	10.89	17.46	17.02	18.07	16.71	13.15	14.48
Actual landings per 10 hrs. by Aberdeen trawlers.....	15.86	14.40	11.02	10.96	15.86	15.58	16.37	16.54	13.14	14.13

¹⁾ Estimated using data from RUSSEL, 1914. ²⁾ No samples taken in October and November.

Faroe Stock. Table 11. Landings of Three Size Categories by Aberdeen Trawlers from Faroe - 1954.**Scottish Investigations.**

The surveys of the Faroe haddock population made by F.R.S. "Scotia" in previous years were not continued during 1954. Market sampling was continued on the usual scale however, and the data are given in Table 10.

Age composition.

The age composition of haddock sampled from commercial trawlers is shown in Table 10 A. The mean lengths of each brood are given in Table 10 B, and in Table 10 C are shown the estimated weights of each brood landed per 10 hours fishing each month. These were determined by converting the mean lengths in Table 10 B to weights (using data from RUSSELL, 1914¹), and then multiplying each by the appropriate number per 10 hours fishing from Table 10 A.

The greater part of the commercial landings was made up of age-groups II—VI (spawned in 1948—1952). Older broods were thinly represented, and on occasions individuals of more than thirteen years age were recorded.

The commercial fishery.

The average weights of haddock, per 100 hours fishing, landed by Aberdeen trawlers

¹ RUSSELL, E. S. (1914), Bd. Agric. and Fish. Inv., Ser. II, Sea Fish., 1, pt. 1.

Cwts. per 100 hours.

Month	Hours fishing	Extra large and large	Medium	Small	Total
January	3165	60.3	47.1	51.2	158.6
February	4036	65.5	38.8	39.7	144.0
March	9105	57.0	35.3	17.9	110.2
April	7931	50.9	35.6	23.1	109.6
May	5112	70.1	46.9	41.6	158.6
June	14023	46.8	42.0	67.0	155.8
July	9814	62.1	48.5	53.1	163.7
August	8525	66.7	46.5	52.2	165.4
September	5135	49.7	41.0	40.7	131.4
October	1555	42.3	65.3	41.9	149.5
November	5799	40.0	52.1	46.7	138.8
December	6365	37.9	67.4	36.0	141.3
Total/Mean . . .	80565	(54.2	45.4	44.2	143.8)

from Faroe during 1954 are shown in Table 11. The tendency noted in the past three years towards a rise in the average catch/100 hours was continued in 1954, the average of 143.8 cwts./100 hours comparing favourably with that of 139.5 in 1953. The corresponding averages in 1951 and 1952 were 124.8 and 125.7 cwts. respectively.

R. JONES, W. MAIN.

North Sea Stock.**Age and Size Composition.**

The haddock population over an extensive area of the northern North Sea was sampled by

Table 12.
Age Composition of Haddock caught by F.R.S. "Explorer" in 1954 per 10 Hours Trawling.

Month	Northern Area					North Central					Central				
	Jan./ Mar.	Apr./ June	July/ Sept.	Oct./ Nov.	All Months	Jan./ Mar.	Apr./ June	July/ Sept.	Oct./ Nov.	All Months	Jan./ Mar.	Apr./ June	July/ Sept.	Oct./ Nov.	All Months
Hrs. trawling	—	4	2	—	6	—	4½	2½	1	8	7	11	87	7½	112½
Year-class					weighted means					weighted means					weighted means
1953	—	1202	865	—	1090	—	1455	1104	1640	1369	203	1408	2955	7664	2947
1952	—	1015	730	—	920	—	982	1040	1370	1049	1237	694	1050	420	985
1951	—	362	205	—	310	—	184	240	160	199	176	31	141	—	123
1950	—	47	50	—	48	—	22	12	10	18	3	5	2	—	1
1949	—	80	30	—	63	—	9	32	10	16	3	1	1	—	1
1948 and over	—	45	15	—	35	—	4	4	—	4	—	—	—	—	—
	—	2751	1895	—	2516	—	2656	2432	3190	2653	1622	2139	4149	8084	4047

Hrs. trawling	Moray Firth and Orkney					Firth of Forth					West				
	13½	10½	—	14	38	14½	14½	—	19½	48½	9	4½	—	3	16½
Years-class					weighted means					weighted means					weighted means
1953	53	230	—	1118	494	1	128	—	388	195	134	396	—	433	260
1952	239	157	—	179	194	168	109	—	33	124	170	1995	—	1166	848
1951	70	53	—	9	43	18	5	—	—	7	222	715	—	67	318
1950	4	2	—	1	2	3	—	—	—	1	22	60	—	27	33
1949	4	3	—	1	3	1	—	—	—	—	2	29	—	13	11
1948 and over	2	—	—	—	—	—	—	—	—	—	2	15	—	10	7
	372	445	—	1307	718	191	242	—	421	329	552	3210	—	1716	1477

F.R.S. "Explorer", and, in particular, cruises in April, June, and July were designed to give complete coverage of the north, north central, and central regions.

Age composition.

The age composition of the haddock captured is given in Table 12, which is based on the numbers and weights landed per 10 hours fishing by commercial trawlers. Catches consisted predominantly of broods produced in 1952 and 1953. These broods were widely although not uniformly distributed. As had been found in previous years the one-year-old fish were most abundant in the central region; while those of 3 years of age and older were most numerous in the north.

The 1954 brood was not strongly represented in the catches and may be assessed as a "poor" year-class.

Table 13. Distribution and Density of the 1954 Brood in "Explorer" Catches, June to November.

Area	No. of fish	No. of hours	Per 10 hrs.
Northern.....	35	4	87
North Central.....	205	5	410
Central.....	452	84½	53
Moray Firth & Orkney.....	143	18	79
Firth of Forth.....	152	19½	78
West.....	271	7½	361
Total for all areas.....	1258	138½	91

Size composition.

The mean sizes of the haddock broods sampled are given in Table 14. The smallest fish, age for age, were found in the north and north central regions. In the central area sizes were consistently larger, while the largest were caught in the Moray Firth or in the neighbourhood of the Orkney Islands.

R. JONES, W. MAIN.

Table 14. Mean Lengths (cm.) and Standard Errors of Haddock of each Age-Group from the North Sea — 1954.

Year-class	Age	Month	Northern			North Central			Central			Moray Firth and Orkney			Firth of Forth			West		
			Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish
1954	0+	June	—	—	Nil	6.0	—	1	—	—	*	—	—	—	—	—	—	—	—	—
		July-Sept.	11.5	0.166	35	—	—	Nil	9.8	0.320	46	—	—	*	—	—	—	—	—	—
		Oct.-Nov.	—	—	*	16.8	0.091	204	17.0	0.086	406	15.9	0.151	143	17.8	0.153	152	15.1	0.099	271
1953	0+	Jan.-Mar.	—	—	*	—	—	*	19.3	0.123	142	18.8	0.146	72	20.5	1.500	2	16.5	0.132	121
	1+	Apr.-June	18.8	0.068	481	18.0	0.054	655	19.5	0.042	1549	20.5	0.096	242	20.1	0.114	186	21.8	0.121	178
	1+	July-Sept.	22.1	0.122	173	23.1	0.103	276	25.0	0.01025712	—	—	—	*	—	—	—	—	—	—
	1+	Oct.-Nov.	—	—	*	23.8	0.121	164	26.5	0.022	5748	26.6	0.0441565	—	27.0	0.062	757	28.2	0.158	130
1952	1+	Jan.-Mar.	—	—	*	—	—	*	28.0	0.094	866	28.2	0.123	323	28.9	0.137	244	28.4	0.155	153
	2+	Apr.-June	25.9	0.119	406	25.4	0.125	442	27.3	0.085	764	29.0	0.171	165	27.1	0.191	158	30.2	0.072	898
	2+	July-Sept.	28.5	0.188	146	29.0	0.146	260	30.6	0.020	9136	—	—	*	—	—	—	—	—	—
	2+	Oct.-Nov.	—	—	*	29.1	0.186	137	33.1	0.122	315	34.6	0.167	251	35.5	0.318	64	34.5	0.121	350
1951	2+	Jan.-Mar.	—	—	*	—	—	*	37.0	0.212	123	35.9	0.257	95	34.9	0.497	26	33.4	0.223	200
	3+	Apr.-June	32.5	0.237	145	30.8	0.289	83	36.0	0.470	34	36.0	0.396	56	34.3	0.837	7	36.7	0.230	159
	3+	July-Sept.	32.7	0.183	41	32.4	0.378	60	34.9	0.055	1224	—	—	*	—	—	—	—	—	—
	3+	Oct.-Nov.	—	—	*	32.8	0.335	16	—	—	Nil	42.5	0.500	12	—	—	Nil	40.6	0.328	26
1950	3+	Jan.-Mar.	—	—	*	—	—	*	46.5	2.500	2	48.2	2.267	5	39.0	1.140	5	41.6	0.952	20
	4+	Apr.-June	36.2	0.724	19	34.0	0.558	10	42.4	1.327	5	42.0	3.000	2	—	—	Nil	41.6	0.460	27
	4+	July-Sept.	35.6	0.476	10	35.3	0.342	3	44.1	1.347	15	—	—	*	—	—	—	—	—	—
	4+	Oct.-Nov.	—	—	*	36.0	—	1	—	—	Nil	49.5	1.500	2	—	—	Nil	45.5	0.535	8
1949	4+	Jan.-Mar.	—	—	*	—	—	*	46.5	2.500	2	52.0	2.950	5	44.0	—	1	42.0	5.000	1
	5+	Apr.-June	40.3	0.656	32	40.5	1.936	4	50.0	—	1	51.3	1.204	3	—	—	Nil	47.7	1.361	13
	5+	July-Sept.	37.8	1.137	6	38.6	1.700	8	44.6	1.660	7	—	—	*	—	—	—	—	—	—
	5+	Oct.-Nov.	—	—	*	43.0	—	1	—	—	Nil	—	—	Nil	—	—	Nil	49.2	0.483	4
1948 and over	5+	Jan.-Mar.	—	—	*	—	—	*	—	—	Nil	—	—	Nil	—	—	Nil	62.5	1.500	1
	and	Apr.-June	44.5	1.004	18	49.0	—	2	—	—	Nil	—	—	58.5	4.500	2	—	Nil	56.1	2.395
	over	July-Sept.	43.0	2.082	3	51.0	—	1	42.5	0.500	2	—	—	*	—	—	—	—	—	—
		Oct.-Nov.	—	—	*	—	—	Nil	—	—	Nil	—	—	Nil	—	—	Nil	58.7	3.481	1

* Not visited.

SAITHE

Icelandic Stock.

During the five last summers saithe has been caught pelagically off the N.-coast of Iceland by means of purse-seines designed for catching herring.

(See Ann. Biol., 8, pp. 42—44, 9, pp. 43—45, and 10, pp. 42—43). The annual yields of this fishery have been as follows (wet weight):—

	Saithe		Herring	
1950	10,000 metric tons		34,335 metric tons	
1951	2,130 — —		58,903 — —	
1952	6,396 — —		11,176 — —	
1953	8 — —		42,568 — —	
1954	1,120 — —		26,600 — —	

The corresponding (Icelandic) annual yields of N.-coast herring are also shown for comparison.

It appears clearly that the yield of saithe has fluctuated very much from year to year as 10,00 tons were taken in 1950 and only 8 tons in 1953. Another interesting thing is that the catches of saithe have varied inversely with the catches of herring, as can be seen from the figures above. This is due to two reasons. 1) When some herring are available on the fishing grounds the vessels concentrate on fishing them, and less attention is paid to the saithe. 2) Inflow of Atlantic water carrying the saithe to the north will prevent the herring-carrying water masses from the north to reach the coastal banks.

In 1950 it was striking to find that the catches of saithe were almost entirely composed of one year-class, the 5-year-old fish. The average size was 65 cm. and the average weight 2.5 kg. In 1951 two year-classes appeared; the 1947 year-brood joined the older

fish from 1945 and since 1951 the catches have always been composed of several year-classes.

In August 1954 2009 fish from two localities were measured, and a sample of otoliths was examined for age. Figure 10 shows the size distribution of the fish in the samples, which were caught on 17. (Mánáreyjar) and 19. August (Grimsey). From earlier experience it is already clear from the length curves that we have to deal with 2-, 3- and 4-year-old fish (broods from 1952, 1951 and 1950). This was also revealed by the age analyses, which gave the following results:—

Age	Brood	‰	Av. length
II.	1952	128	35.91 cm.
III.	1951	813	41.91 —
IV.	1950	47	54.50 —
?	?	12	—

It must be noted that the otoliths were taken from the sample where the young fish were less predominant, and, consequently, there must have been relatively greater numbers of 2-year-old fish than indicated by the figures.

Looking back over the 5-year period 1950—54 it would be interesting to find out which year-broods have appeared off the N.-coast during these years. Considering the survey below two facts become apparent. Firstly, that any year-brood within the period 1945—52 has been met with. This probably indicates there to be a relatively strong flow of warm water from the S.-coast, and it must be remembered that during this same period and later the herring season off the N.-coast has almost entirely failed, 1945 was the first poor year. The other thing to note is the age of the saithe, which has been ranging between 1 and 7 years. The upper limit (7 years) corresponds roughly with the age at first maturity, when the fish must leave for the southern grounds in order to spawn.

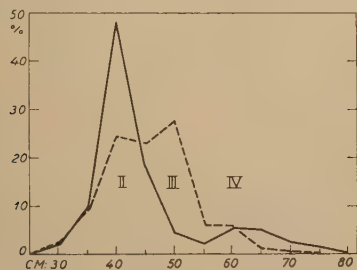


Figure 10. Length composition of saithe, N. Iceland. Age analysis 17. (---) and 19. (—) August 1954. The peaks correspond to age-groups II, III, and IV.

	Summers				
Year-broods	1950	1951	1952	1953	1954
1945	+	+	—		
1946				—	
1947		+	+		
1948				+	
1949			—		
1950			+	—	
1951			+		+
1952					+

As long ago as in 1950 the question arose whether the toll taken of the young fish by

this new fishery might influence the yields of the saithe stock in Icelandic waters later when the exploited year-class would appear as large saithe in trawl catches. The 5-year period we have on record is perhaps too short to allow any general conclusions. But as far as our experience goes it cannot be proved that harm has been done to the stock by the purse-seine catches. The total annual catch of saithe in Icelandic waters, during the last seven years of statistical records, is as follows:—

in 1947	40,235 tons
— 1948	108,740 —
— 1949	84,755 —
— 1950	53,150 —
— 1951	74,096 —
— 1952	87,940 —
— 1953	72,783 —

If damage had been done to the stock by the purse-seine catches in 1950, when the output amounted to 10,000 tons as mentioned earlier, it should have been reflected in smaller total yields in 1952, when the 7-year-old fish entered into the trawlers' catches as large saithe. However, this has not been the case. The total yield of saithe was higher in 1952 than in any other year since 1948, and higher than the average of the whole post-war period which was 76,243 tons. The total catch in 1952, therefore, exceeded the average by nearly 16%. However, a decline in the total yield was noted in 1953.

ÁRNI FRÍÐRIKSSON.

Norwegian Stock.

Marking Experiments.

On 17. August 1954, 528 tagged saithe were released in Oksefjorden, Finnmark (71°05'N., 27°23'E.). The tags were of the usual Lea type, fastened with double 0.50 mm. nylon in the neck of the fish, just in front of the first dorsal fin.

The fish, which were caught with a purse-seine near the surface, ranged from (50) 60 to 103 cm. in total length. A random sample of the same catch showed only sexually mature specimens.

At present (22.4.55), we have reports of 113 recoveries, or 21.4% of the number released.

In the first three months after the release 68 recoveries were reported, the major part of which was made on or near the tagging locality. The distribution of these is shown in Figure 11.

The large number of recoveries in September

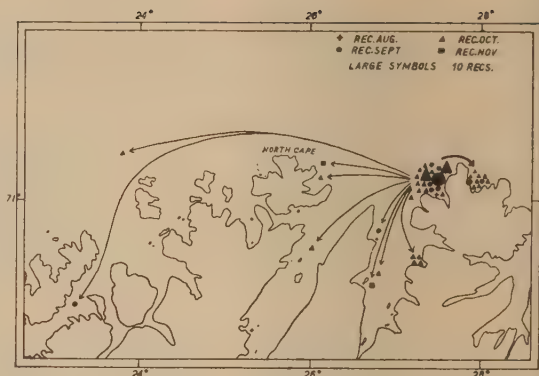


Figure 11. Recoveries in the first three months after tagging.

and October is chiefly due to the purse-seine fishery, which in these months was rather intensive in the area of the tagging locality.

Usually the whole saithe shoal is caught by the purse-seine when the shot is successful, and one could therefore expect to get a large number of tagged fish in some catches and none in others. However, the recoveries from the tagging locality are derived from many different catches, the largest number in one catch being twelve. Hence, the tagged fish must have been dispersed in a number of different shoals after release.

The localities of the recoveries in the last four months are shown in Figure 12. Except for the most northern one in the Barents Sea, which measured only 71 cm. and therefore might have been immature, these recoveries were of saithe which most probably were on the way to, or on the spawning grounds.

Table 15. Records of recaptured Saithe, tagged in the Oksefjord Finnmark (71°05'N., 27°23'E.) on 17. August 1954.

Month of recapt.	Type of gear			Nationality of vessel			Total
	Purse-seine	Trawl	Other gears	Norwegian	British	German	
Aug. . . .	—	—	1	1	—	—	1
Sept. . . .	18	—	1	19	—	—	19
Oct. . . .	44	1	1	46	—	—	46
Nov. . . .	—	—	2	2	—	—	2
Sum I. . .	62	1	5	68	—	—	68
Dec. . . .	—	4	2	2	1	3	6
Jan. . . .	—	18	—	1	—	17	18
Febr. . . .	—	10	2	3	2	7	12
March. . .	—	9	—	—	—	9	9
Sum II. . .	—	41	4	6	3	36	45
Total. . .	62	42	9	74	3	36	113

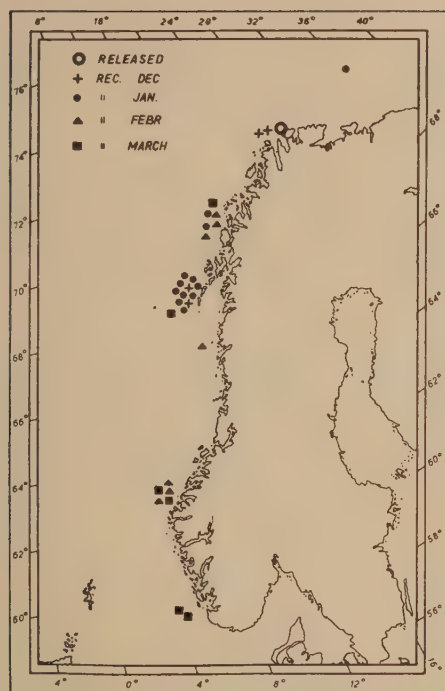


Figure 12. Recoveries four to seven months after tagging.

From Table 15, which gives the records of the recoveries by months, type of gear, and nationality of vessel, it is seen that up to December there are only Norwegian recoveries and the purse-seine is dominant. The major part of the recoveries in the winter months was made by German trawlers, reflecting the importance of the German trawl fishery for saithe at the Norwegian coast.

We have also tried to tag saithe caught with trawl or bottom nets, but it seems as if this species is very sensitive to the treatment of the gears and to rapid variations in water pressure. It is therefore, difficult to tag saithe from fish caught with these gears.

On the other hand we have tagged 98 small saithe (24—52 cm.), caught with tin-bait near the surface. They seemed to stand the treatment quite well and were all in good condition. This tagging was carried out in the beginning of August 1954 in the position 71°00'N., 24°44'E. Till now we have reports of two recoveries, one in September and one in October 1954.

STEINAR OLSEN.

WHITING

North Sea Stock.

German Observations.

From July to November 1954 investigations were carried out on the biology of the whiting (*Gadus merlangus* L.) in the North Sea and these will be continued in 1955.

Samples were taken on various fishing

grounds and in the German Bight during several cruises with commercial fishing vessels and the R/V "Uthörn". A total of 3907 otoliths have been examined up to now in order to determine the age composition of the stock. The percentage age distribution in the areas from which samples were taken are given in Table 16; the figures in brackets represent the

Table 16.

	German Bight Sept.—Nov.		White Bank July	Dogger Bank Sept.—Oct.	Devils Hole Aug.	Fladen Ground Aug.
	Cutter trawl with sole cod-end 10—20 m.	Helgoland trawl 30—40 m.	Tuckzeese 40—50 m.	Herring trawl > 40 m.	Herring trawl 90—100 m.	Herring trawl > 100 m.
Depth						
Age-Group						
0.....	— (—)	9.1 (23)	— (—)	0.3 (4)	— (—)	— (—)
I.....	6.6 (22)	14.7 (37)	10.2 (61)	4.4 (62)	2.0 (14)	— (—)
II.....	14.3 (48)	7.5 (19)	29.5 (177)	10.5 (150)	2.9 (21)	1.4 (8)
III.....	25.1 (84)	13.1 (33)	31.3 (188)	28.3 (403)	14.9 (107)	11.1 (64)
IV.....	21.5 (72)	23.8 (60)	12.0 (72)	31.3 (446)	23.0 (165)	18.2 (105)
V.....	19.7 (66)	22.2 (56)	6.3 (38)	18.2 (260)	26.1 (187)	21.5 (124)
VI.....	11.0 (37)	9.1 (23)	4.2 (25)	6.1 (87)	19.7 (141)	22.5 (130)
VII.....	1.8 (6)	0.4 (1)	4.0 (24)	0.8 (11)	9.6 (69)	16.4 (95)
VIII.....	— (—)	— (—)	2.3 (14)	0.2 (3)	1.7 (12)	9.0 (52)
IX.....	— (—)	— (—)	0.2 (1)	— (—)	— (—)	— (—)
Total.....	100% (335)	100% (252)	100% (600)	100% (1426)	100% (716)	100% (578)

Table 17.

Age-Group	German Bight			White Bank			Dogger Bank			Devils Hole			Fladen Ground		
	♂	♀	Total	♂	♀	Total	♂	♀	Total	♂	♀	Total	♂	♀	Total
0.....	—	—	16.3	—	—	—	—	—	17.7	—	—	—	—	—	—
I.....	20.3	20.3	20.3	17.8	18.2	18.0	22.5	22.6	22.6	[20.8]	[22.0]	21.4	—	—	—
II.....	24.0	26.2	25.1	20.9	22.3	21.6	22.5	22.8	22.7	23.2	23.6	23.4	[23.5]	[24.8]	[24.2]
III.....	25.9	27.3	26.6	22.6	24.2	23.4	24.6	25.4	25.0	25.0	26.1	25.6	25.5	26.1	25.8
IV.....	25.5	29.2	27.4	24.1	27.0	25.6	25.7	27.2	26.5	25.7	27.8	26.8	26.2	27.7	27.0
V.....	27.5	30.3	28.9	27.3	33.0	30.1	27.3	29.6	28.5	28.0	29.9	29.0	27.6	29.9	28.8
VI.....	29.4	32.0	30.7	[28.4]	34.9	31.1	29.3	32.7	31.0	29.9	32.8	31.4	30.2	32.1	31.2
VII.....	[30.6]	[37.5]	[34.1]	[30.8]	37.2	34.0	[32.1]	[37.5]	34.8	32.1	37.9	35.0	32.2	36.4	34.3
VIII...	—	—	—	[35.5]	[40.6]	38.1	[37.0]	[41.5]	[39.3]	[35.8]	[44.3]	40.1	34.5	41.3	37.9

number of whiting investigated. It is obvious that older fish prefer deep water.

Table 17 shows the average lengths of the age-groups in centimetres. If less than ten fish were examined the mean values are given in brackets.

Within the first three years of life the whiting reach a mean length of about 23 cm. For the next three years there is an annual growth-rate of about 2 cm. It is remarkable that later on the growth-rate increases once more.

J. MESSTORFF.

APPENDIX¹⁾

Cod in West-Greenland Coastal Waters and Offshore Banks 1954.

1. Occurrence of cod eggs and larvae. (See Figure 1).

The catches of cod larvae from the "Dana" show a more scattered distribution than in 1953. The largest numbers were taken on stations between 66 and 67°N. In contrast to 1953 some cod larvae were taken south of 64°N. Catches of cod larvae on two stations on the section Cape Farewell—Hamilton Inlet indicate probably a drift of cod fry from spawning grounds outside the West-Greenland area (Iceland?).

2. Composition of year-classes in catches of cod. (See Figures 2 and 3).

a) Offshore banks.

3088 samples of cod otoliths have been collected in offshore waters. Included in these samples are 2298 collected by the "Dana" from catches taken with hand-lines on the fishing banks, 281 samples are from catches with long-lines from the "Adolf Jensen" (No. 8) while 267 and 242 are from catches with long-lines and otter trawl from a Portuguese dory-carrying vessel (No. 2) and a Faroese trawler (No. 9) respectively.

The results of the age analyses of the samples together with the length distributions are given on the map, Figure 2. It is seen that the sample from the west coast of Disko (No. 1) differs from the other samples with the 1942 year-class as the predominant year-class and the 1947 year-class much less represented than in the other samples. It appears from Figure 2 that the 1947 year-class has been the predominant year-class with one exception (No. 1) as in 1953. In all the fourteen catches examined it has amounted to more than 20 %, in twelve it was more than 30 %, in nine it was more than 40 % and in eight it was more than 50 %. Only in one sample does it amount to more than 60 % (No. 5, Figure 2).

The 1945 year-class has been of much less importance than in previous years amounting to less than 20 % in all samples with exception of the sample from Dana Bank where it amounts to 26.8 %.

The 1942 year-class has been very poorly represented in the samples with exception of sample 1 where it predominates with 31.2 %. In the remaining samples there was only one (No. 8) in which it exceeds ten percent (10.8 %).

Year-classes older than the 1942 year-class have only been traced in very small numbers. Among these the old 1934 year-class (20 years old) and 1936 (18 years old) which pre-

¹⁾ This contribution was received too late to be inserted in its proper place and is therefore printed as appendix.

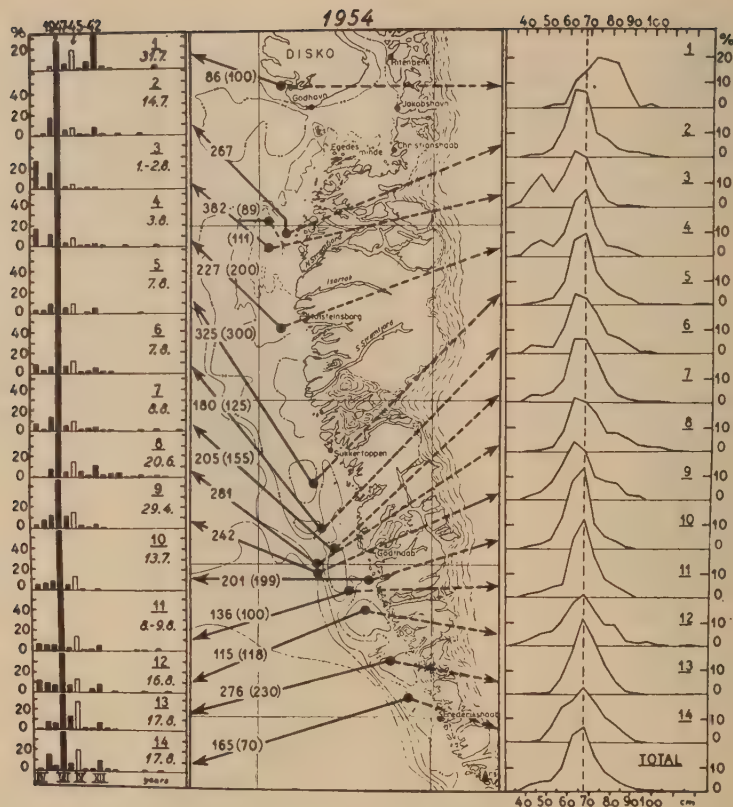


Figure 2. Compositions of year-classes and length compositions in catches from offshore banks.
Numbers on the arrows indicate numbers of cod examined. Numbers in brackets indicate numbers of cod tagged.

the cod fishery in Frederikshåb and Julianehåb district (60° — $62^{\circ}30'N.$). The question now is what has happened to the 1945 year-class? Two obvious reasons exist (a) high mortality caused by overfishing and (b) migrations to other areas.

As for (a) it is a fact that a very extensive trawl fishery mainly by British trawlers has been carried out in the open sea outside the coast of Julianehåb district. From the British report (see ICNAF, Ann. Proc., 3, p. 47, 1953) it appears that the fishery has been prosecuted chiefly on the 1945 year-class, which in 1952 amounted to about 60 % in the trawl catches. There may be reason to believe that the heavy exploitation by trawl on a stock which consists chiefly of a single year-class and which occurs in a rather limited area would be disastrous.

As for (b) we have seen by tagging ex-

periments that an extensive migration of cod from Julianehåb district has taken place in the thirties. Regarding the small number of recaptures in Icelandic waters of cod tagged off West Greenland in the years after the war the tagging experiments have not shown an extensive migration even if the number of cod tagged in the district in question has been much bigger than before.

On the other hand according to verbal information given by Mr. JÓNSSON the 1945 year-class has occurred in the spawning shoals off Iceland in spring 1954 in a quantity about 25 % more than he had calculated in advance. This fact indicates an immigration of cod of this year-class from other regions probably from South Greenland. This is not in agreement with the few recaptures of tagged Greenland cod off Iceland as mentioned above. Another explanation is that a great emigration



Figure 3. Composition of year-classes, coastal waters and fjords, 1954.

of cod belonging to the 1945 year-class has probably taken place from the southernmost districts in Greenland but that a large number of these emigrants have not succeeded in reaching the Iceland spawning grounds but have strayed out in the open sea where they have perished. One recapture in the Lofoten area of Norway of a tagged Greenland cod probably supports this assumption. The recapture in question is of a cod with a total length of 69 cm. at recapture and an age of nine years, the 1945 year-class. The place of recapture was Røst, position $67^{\circ}20'N.$, $13^{\circ}30'W.$ It was recaptured in the middle of April 1954 by a German trawler. The cod was tagged 18. September 1952 off Nanortalik,

$60^{\circ}10'N.$, $45^{\circ}28'W.$ The tag used was a yellow plastic tag.

Concerning the year-classes younger than the 1947 year-class the 1950 year-class has been most strongly represented in the catches from the coastal area as in the catches from the banks. The reason why it only appears on a modest scale in the samples in Figure 3 is that the cod belonging to this year-class are of a small size mostly below 50 cm. and therefore discarded by the fishermen as undersized and thrown overboard. In the sample E which was collected exclusively for age analysis, the 1950 year-class amounts to about 20 %. In catches from Julianehåb district with fine-meshed seine and with small jiggs especially for taking small cod the 1950 year-class occurs in rather large numbers. There is reason to believe that this year-class will be of importance in the fishery in the future.

Among the smallest cod, I—III group, the I-group (1953 year-class) was observed in rather large shoals close to the shore and it was caught by seine in large numbers at Holsteinsborg and in Julianehåb district.

3. Length measurements of cod from the banks. (See Figure 2 and Table 1).

The length distributions in 5 cm. groups are given in Figure 2. The numbers on the graphs correspond with the numbers of the age analyses to the left on Figure 2. If we ignore the sample No. 1 we see that the peak on the graphs are lying between 60—65 and 65—70 cm. corresponding with the age compositions of the samples in which the 1947 year-class is strongly predominant. In the samples No. 3 and 4 the 1950 year-class appears very clearly. Compared with the length compositions of cod in the catches in 1953 it is obvious that the length compositions in the catches in 1954 are much more even than in the previous year. The catches contained a smaller number of big cod especially on the middle and southern banks but the great bulk of the cod was of a more valuable size for salting than in 1953, in which year a large number of undersized cod occurred in the catches. The better sizes are due to the growth of the dominant year-class 1947 which in 1954 has a mean size between 60—65 cm. corresponding to mean weights between about 2—2.5 kg. (round fresh weight).

In this connexion it is worth to mention that the quality of the cod has been good

Table 1. Age and Length Composition of Cod on Greenland Banks.

Year-class	Age-group	1 Off Disko 69°27'N., 54°22'W. 31. July			2 Store Hellefiske Bank 67°55'N., 54°20'W. 14. July			3 Store Hellefiske Bank 68°03'N., 54°42'W. 1.—8. August			4 Store Hellefiske Bank 66°52'N., 54°29'W. 3. August		
		Length cm.			Length cm.			Length cm.			Length cm.		
		%	♂♂	♀♀	%	♂♂	♀♀	%	♂♂	♀♀	%	♂♂	♀♀
1950.....	IV	—	—	—	0.4	50.0	—	26.0	44.8	45.3	17.2	46.1	46.6
1949.....	V	—	—	—	2.2	53.0	45.8	1.9	52.0	50.0	0.9	52.0	56.0
1948.....	VI	3.5	52.0	58.5	15.4	59.3	59.5	14.6	58.2	55.8	11.4	58.5	62.8
1947.....	VII	25.6	61.6	64.7	59.5	63.3	65.3	50.1	63.1	63.3	54.1	65.0	65.7
1946.....	VIII	5.8	68.0	68.0	4.5	74.3	70.8	2.1	63.3	63.5	3.1	70.7	70.8
1945.....	IX	18.6	70.3	71.7	6.7	77.0	73.7	3.4	71.4	78.3	7.5	75.7	78.6
1944.....	X	1.2	77.0	—	2.2	73.0	84.3	0.3	67.0	—	0.9	76.0	81.0
1943.....	XI	7.0	79.7	75.7	0.7	73.0	94.0	0.8	81.5	76.0	1.3	77.0	82.0
1942.....	XII	31.2	78.2	80.2	6.4	83.4	87.5	0.8	74.0	88.0	1.8	79.0	78.5
1941.....	XIII	2.3	89.0	87.0	—	—	—	—	—	—	0.4	84.0	—
1940.....	XIV	1.2	—	80.0	—	—	—	—	—	—	—	—	85.0
1938.....	XVI	—	—	—	—	—	—	—	—	—	0.4	—	85.0
1934.....	XX	3.5	96.0	111.0	—	—	—	—	—	—	0.9	84.0	—
Total.....		86			267			376			227		
Depth m.....		30—50			—			29			30		
Temperature °C.....		2.1			—			3.7			3.5		

Year-class	Age-group	5 Lille Hellefiske Bank 65°01'N., 53°22'W. 7. August			6 Banana Bank 64°27'N., 53°13'W. 7. August			7 Fylla Bank 64°10'N., 52°51'W. 8. August			8 Fylla Bank 64°04'N., 53°22'W. 20. June		
		Length cm.			Length cm.			Length cm.			Length cm.		
		%	♂♂	♀♀	%	♂♂	♀♀	%	♂♂	♀♀	%	♂♂	♀♀
1950.....	IV	4.3	43.6	47.3	8.3	44.6	45.3	7.3	47.0	49.5	0.7	—	46.5
1949.....	V	2.8	54.0	57.3	3.3	52.7	54.0	2.0	57.0	52.7	0.4	—	49.0
1948.....	VI	9.2	60.6	58.8	6.1	55.0	58.6	13.2	60.8	62.0	8.3	58.9	60.8
1947.....	VII	63.4	63.7	64.9	55.5	64.7	66.2	55.6	64.6	65.8	44.2	62.4	64.7
1946.....	VIII	4.9	70.3	69.4	6.4	72.0	71.5	4.4	70.2	68.4	4.7	70.2	70.6
1945.....	IX	9.2	70.9	75.4	11.7	74.2	75.7	8.8	72.5	74.1	14.7	71.4	72.4
1944.....	X	—	—	—	1.1	82.0	—	1.5	78.0	70.0	4.3	77.0	75.2
1943.....	XI	1.2	—	78.5	1.1	80.0	85.0	1.5	70.5	74.0	1.4	70.0	73.3
1942.....	XII	4.6	75.1	84.0	4.4	82.5	82.8	2.9	77.5	84.5	10.8	84.3	82.8
1941.....	XIII	—	—	—	1.1	80.0	95.0	0.5	—	103.0	1.8	88.5	96.3
1940.....	XIV	—	—	—	0.6	—	89.0	0.5	—	84.0	2.2	85.5	93.8
1939.....	XV	—	—	—	—	—	—	—	—	—	2.9	85.6	84.8
1936.....	XVIII	0.9	85.0	94.0	—	—	—	0.5	78.0	—	—	—	—
1934.....	XX	—	—	—	—	—	—	1.0	104.0	83.0	—	—	—
Total.....		325			180			204			281		
Depth m.....		40—60			43—50			40			—		
Temperature °C.....		—			—			2.6			—		

during the whole season in contrast to 1953 when the cod was very lean and with low liver content especially in the first part of the fishing season.

The good quality and the high liver content have been caused by good feeding conditions in the previous year when large amounts of valuable cod food as capelin (*Mallotus*), sandeels (*Ammodytes*), small cephalopods (*Conatus*) occurred. The occurrence of cod food was very poor in the cold year 1952 and the quality of the cod was very bad in the following year as mentioned above.

In 1954 the feeding conditions for cod has

been favourable as in 1953 so that there is reason to expect that the cod in 1955 will also be of good quality.

4. Tagging experiments.

A total of 3801 cod has been tagged in 1954. 2004 have been tagged on the offshore banks while 1797 have been tagged in coastal waters and in the fjords. From these experiments 103 recaptures have been taken in 1954. In total 426 recaptures have been reported 402 from Greenland waters and 23 from Iceland. In Table 3 a survey is given of the recaptures according to age-groups and year.

Table 1. (continued).

Year-class	Age-group	9			10			11			12		
		Fylla Bank			Off Færingerhavn			Fylla Bank			Fiskenæs Bank		
		63°53'N., 53°22'W.			63°38'N., 51°41'W.			63°41'N., 52°27'W.			63°26'N., 51°59'W.		
		29. April			13. July			8.—9. August			16. August		
		%	Length cm.		%	Length cm.		%	Length cm.		%	Length cm.	
	♂♂	♀♀		♂♂	♀♀		♂♂	♀♀		♂♂	♀♀		
1950.....	IV	3.3	47.3	43.5	5.5	53.7	46.6	6.6	48.4	43.3	12.2	47.1	40.5
1949.....	V	6.6	53.8	51.7	7.0	56.0	56.3	4.4	50.3	52.3	9.6	54.6	61.3
1948.....	VI	12.0	56.5	57.5	8.5	57.3	59.8	4.4	64.3	59.3	7.0	56.6	58.7
1947.....	VII	46.7	62.2	64.2	59.5	63.6	64.5	59.5	64.5	66.1	39.1	64.0	66.7
1946.....	VIII	10.7	67.5	67.0	5.5	67.8	71.6	2.9	73.3	71.0	6.1	65.0	70.8
1945.....	IX	14.5	78.5	78.3	12.5	70.6	76.0	13.2	73.4	75.4	12.2	73.4	75.0
1944.....	X	2.1	83.0	80.3	1.0	74.5	—	0.7	—	79.0	—	—	—
1943.....	XI	0.8	75.0	—	—	—	—	0.7	76.0	—	3.5	76.8	—
1942.....	XII	2.9	78.7	82.0	1.0	—	79.0	4.4	73.8	79.0	7.8	75.6	101.0
1941.....	XIII	0.4	—	90.0	—	—	—	—	—	—	—	—	—
1940.....	XIV	—	—	—	—	—	—	—	—	—	0.9	—	80.0
1937.....	XVI	—	—	—	—	—	—	0.7	79.0	—	—	—	—
1936.....	XVIII	—	—	—	—	—	—	0.7	—	83.0	0.9	—	98.0
1934.....	XX	—	—	—	—	—	—	1.5	—	92.5	—	—	—
Total.....		238			201			136			115		
Depth m.....		150			—			45			43		
Temperature °C.....		0.8			—			—			1.7		

Year-class	Age-group	13			14		
		Dana Bank			Frederikshåb Bank		
		62°47'N., 51°12'W.			62°15'N., 50°47'W.		
		17. August			17. August		
		%	Length cm.		%	Length cm.	
	♂♂	♀♀		♂♂	♀♀		
1950....	IV	1.1	45.0	53.0	1.2	45.0	—
1949....	V	6.5	58.0	50.7	14.5	55.4	55.2
1948....	VI	5.8	61.3	62.0	3.6	60.5	59.5
1947....	VII	35.9	64.3	67.1	39.4	62.4	65.1
1946....	VIII	13.4	67.1	70.3	5.5	68.8	71.8
1945....	IX	26.8	71.2	74.0	20.0	71.6	79.9
1944....	X	1.4	72.8	—	1.2	67.0	—
1943....	XI	1.1	69.0	76.0	1.2	—	84.0
1942....	XII	6.9	74.3	78.5	9.6	76.0	80.4
1941....	XIII	0.7	76.0	75.0	1.8	82.7	—
1940....	XIV	0.4	—	87.0	0.6	78.0	—
1936....	XVIII	—	—	—	0.6	85.0	—
1934....	XX	—	—	—	0.6	83.0	—
Total.....		276			162		
Depth m....		52			55		
Temperature °C		0.5			0.4		

classes, year of tagging and whether the recapture has been made off Greenland or off Iceland.

The recaptures off Iceland have only amounted to 7.5 %, (recaptures from the tagging experiments in 1954 omitted) this was a smaller percentage than in 1953 when it was 13.3 %, (in the report it was given as 14.2 % but thirteen recaptures from Greenland in 1953 were sent us in 1954).

It is seen that the three rich year-classes 1947, 1945 and 1942 have amounted to 69.3 % of the age-analysed recaptures from Green-

land while only two year-classes, 1944 and 1945, were found in the recaptures from Iceland. The numbers of the latter year-class are four times bigger than the former. As mentioned above the results of the tagging experiments have given no evidence of an extensive migration to Iceland as in the thirties.

As mentioned above there has been a recapture from Lofoten in Norway. It is the second example of a cod which has migrated from Greenland to the north-eastern Europe. The first was a cod which was tagged off Nanorta-

Table 2. Age Determination of Cod. Coastal Waters and Fjords.

Year-class	Age-group								
		A	B	C	D	E	F	G	H
1950...	IV	—	5.0	6.5	9.1	20.6	0.5	12.2	5.3
1949...	V	—	2.4	1.0	3.7	6.3	1.5	13.1	17.1
1948...	VI	—	10.7	14.0	4.7	11.1	4.5	2.7	1.6
1947...	VII	2.0	67.8	74.5	29.1	33.3	49.0	29.5	31.2
1946...	VIII	—	0.8	1.5	0.3	2.4	1.0	0.2	0.7
1945...	IX	7.5	6.0	1.5	11.5	11.9	14.5	19.4	36.6
1944...	X	1.5	0.6	0.5	1.7	4.8	2.5	0.5	1.4
1943...	XI	4.0	1.4	—	1.4	1.6	1.0	1.2	0.9
1942...	XII	29.8	4.0	0.5	15.9	1.6	17.5	9.7	3.5
1941...	XIII	5.1	0.1	—	1.0	1.6	—	0.5	—
1940...	XIV	13.6	0.8	—	12.2	—	6.0	3.0	0.7
1939...	XV	6.1	—	—	1.7	1.6	0.5	0.5	0.2
1938...	XVI	1.0	—	—	3.7	—	0.5	1.0	0.2
1937...	XVII	0.5	—	—	1.4	0.8	—	0.2	—
1936...	XVIII	11.6	0.4	—	2.4	2.4	—	4.7	0.2
1935...	XIX	0.5	—	—	—	—	—	—	—
1934...	XX	16.2	0.1	—	0.3	—	1.0	1.0	0.2
1933...	XXI	0.5	—	—	—	—	—	—	—
1932...	XXII	—	—	—	—	—	—	0.5	—
Total.....			198	907	200	296	126	200	403 432

lik 22. September 1932 and recaptured 2. March 1938 off Cape Kanin (see Rapp. et Proc.-Verb., 123, p. 59).

If we consider the age determinations of cod recaptured in Greenland waters, it is seen that the 1947 year-class is represented with the highest number (77), next comes the 1945 year-class (45), 1942 (27) and 1940 (21). In

Table 4. Recaptures made by different Nations from Greenland and Iceland in 1953 and 1954.

Nations	Recaptures from			
	Greenland		Iceland	
	1953	1954	1953	1954
Denmark.....	38	10	—	—
Greenland.....	87	100	—	—
Faroes.....	6	7	—	—
Norway.....	11	12	—	—
Iceland.....	26	6	22	10
United Kingdom.....	15	10	2	3
France.....	11	7	—	—
Germany.....	—	1	3	10
Portugal.....	39	247	—	—
Spain.....	—	2	—	—
Total.....	233	402	27	23

the recaptures from Iceland only two year-classes occur, namely 1944 and 1945, with 3 and 11 specimens respectively. The strong 1947 year-class was not represented in the recaptures from Iceland which could be aged.

Among the 23 recaptures from Iceland 14 originate from tagging experiments in Julianehåb district, 3 have been tagged on Store Hellefiske Bank, 1 on Lille Hellefiske Bank, 2 on Fylla Bank, 1 on Fiskenes Bank, 1 is tagged in coastal waters in Sukkertoppen district while 1 is tagged in Ameralik Fjord in Godthåb district.

Of special interest is two recaptures of cod on Store Hellefiske Bank. Both were tagged

Table 3. Recaptures from 1954 of Age-Determined Cod tagged in different Years' Tagging Experiments.

Year-class	Age-group	Year of tagging												Total						
		1946		1948		1949		1950		1951		1952		1953		1954		Gr.	% ²⁾	Ic.
		Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.	Gr.	Ic.			
1934.....	XX	1	—	—	—	1	—	—	—	—	—	3	—	1	—	1	—	7	3.3	—
1936.....	XVIII	—	—	—	—	—	—	1	—	1	—	1	—	—	—	2	—	5	2.4	—
1937.....	XVII	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.5	—
1938.....	XVI	—	—	—	—	—	—	—	—	—	—	2	—	2	—	1	—	5	2.4	—
1939.....	XV	—	—	—	—	—	—	—	—	1	—	—	—	1	—	1	—	3	1.4	—
1940.....	XIV	—	—	1	—	—	—	—	—	1	—	10	—	5	—	4	—	21	9.9	—
1941.....	XIII	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	2	0.9	—
1942.....	XII	—	—	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
1943.....	XI	—	—	—	—	—	—	3	—	1	—	6	—	9	—	7	—	27	12.7	—
1944.....	X	—	—	—	—	—	—	1	—	—	—	—	—	1	—	2	—	4	1.9	—
1945.....	IX	—	—	—	—	—	—	—	—	1	1	2	1	—	1	2	—	5	2.4	3
1946.....	VIII	—	—	—	—	2	1	1	1	2	1	12	8 ¹⁾	15	1	13	—	45	20.8	12 ¹⁾
1947.....	VII	—	—	—	—	—	—	—	—	—	—	—	—	1	—	3	—	4	1.9	—
1948.....	VI	—	—	—	—	1	—	—	—	1	—	9	—	42	—	24	—	77	35.8	—
1949.....	V	—	—	—	—	—	—	—	—	—	—	—	—	1	—	4	—	5	2.4	—
?		—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	3	1.4	—
		—	—	1	—	2	—	1	—	6	3	47	5	94	1	37	—	188	—	9
Total.....		2	0	4	0	6	1	7	1	14	5	92	14 ¹⁾	174	3	103	0	402		42 ¹⁾

¹⁾ Including one recaptured off Lofoten, Norway.

²⁾ % of age-determined cod only.

by hydrostatic tags (Lea tags) in 1949. One was tagged in Umanak Fjord. It measured 19 cm. when tagged and was recaptured 225 miles south of the tagging locality.

The other was tagged off Ritenbenk ($69^{\circ}44'N.$, $51^{\circ}20'W.$). Its total length when tagged was 24 cm. and it was recaptured 150 miles south of the tagging locality.

In Table 4 the number of recaptures reported from the different nations from Greenland and Iceland in 1953 and 1954 is given. The large

number of recaptures taken by Portuguese fishermen is remarkable even if we take in consideration that extensive tagging has been carried out on the Store Hellefiske Bank, where the largest number of Portuguese vessels are fishing at the very time of tagging. If we leave out the recaptures in the year of tagging the number of recaptures by Portuguese ships are in 1953, 27 and in 1954, 185.

PAUL HANSEN.

Herring.

INTRODUCTION

Contributions to this, the sixth, report of the Herring Committee have been received from the following countries:—

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REPORTS

A. Atlantic Waters.

COMMERCIAL FISH

Iceland.

The Icelandic North Coast Herring in 1954.

The summer of 1954 was the 10th season of bad yields of herring on the north coast of Iceland. The total catch amounted to 26,600 tons only, which was the lowest yield of the period with one exception, 1952. About 71% were reduced to oil and meal, 6% were frozen for bait, and 23% were salted for human consumption. The greatest part of the yield was taken in July, in spite of exceptionally bad weather conditions, whereas the fishing in August failed almost entirely.

The material investigated originated this

time from two main sources, the commercial fishing off the N.-coast, (mainly purse-seine) and from the research vessel "Ægir" (drift-nets). Only the samples which came from the commercial catches are comparable with the material of previous years. They comprised 2094 herrings altogether. The localities of sampling are indicated by black dots on the map Figure 1. The material from "Ægir" had to a great extent been collected outside the N.-coast fishing ground as shown by the circles on the figure. It comprised 1439 herrings.

In Table 1 the size distribution of the herring is shown specified as to time and localities of catching (for general survey see Figure 2). Considering first the north-coast herring upon

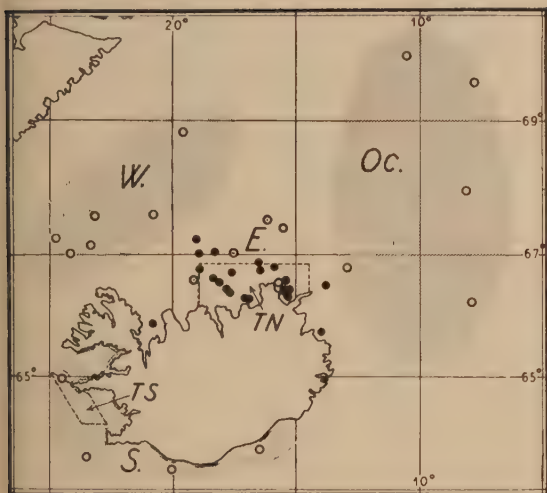


Figure 1. Localities of sampling. The samples originated partly from the commercial fishery (●), partly from the "Ægir". (○). W = western area, Oc. = open ocean, S = southern area, TN = tagging area off the N.-coast (boundaries stippled), TS = tagging area off the SW.-coast.

which the fishing was based, and which we will deal with in the following, it appears that we mostly have to do with very large fish, the curves for both July and August showing peaks at 36 cm. These peaks correspond to the older individuals of the main stocks. Another peak is noticed at 32 cm., corresponding to the herring of Icelandic origin constituting a rela-

Table 1. Size Distribution of Herring (‰).

cm.	N.-coast		Oc.	Oc.	"Ægir"		Tagged herring	
	July	Aug.	VI	VII	V	E	S	N.-c.SW.-c.
41....	1	—	—	—	—	—	—	—
40....	—	—	—	—	—	—	—	—
39....	9	7	—	—	3	—	—	17
38....	61	38	6	7	33	19	—	94
37....	218	148	92	59	163	72	3	254
36....	281	193	361	268	418	166	—	244
35....	146	136	371	358	300	226	57	115
34....	58	91	138	130	46	166	72	75
33....	50	134	24	20	20	79	72	87
32....	87	157	8	26	10	147	109	80
31....	62	74	—	33	7	106	213	28
30....	26	10	—	72	—	11	146	6
29....	1	2	—	20	—	4	132	+
28....	—	—	—	—	—	—	112	—
27....	—	5	—	7	—	4	46	+
26....	—	5	—	—	—	—	32	+
25....	—	—	—	—	—	—	3	—
24....	—	—	—	—	—	—	—	—
23....	—	—	—	—	—	—	3	—
Σ....	1000	1000	1000	1000	1000	1000	1000	1000
Number	1494	600	371	153	302	265	348	8758
Mean								
(cm.)	35.15	34.36	35.06	34.50	35.71	34.07	30.61	36.47
							32.36	

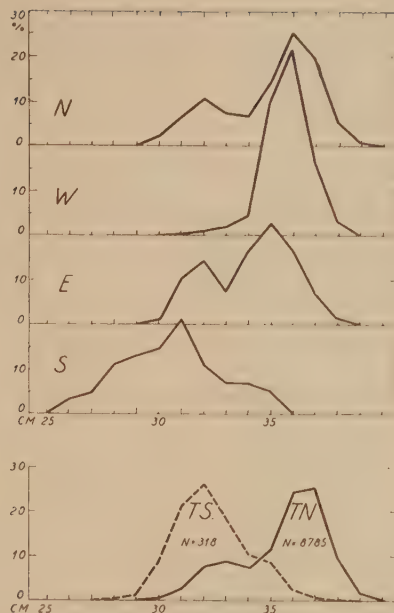


Figure 2. Size distribution of the herring from the north coast (N, commercial fishery), western area (W), eastern area (E) and the south and south-west coasts (S). Size of tagged herring off the south-west coast (TS) and off the north coast (TN).

tively larger part of the catches in August than in July. In the samples from "Ægir" taken in the open ocean (area Oc. in Figure 1.) in June (Oc. VI in the table) and July (Oc. VII in the table) the small herring is practically absent and the oldest individuals are not as numerous as in coastal waters. On the other hand there appears a peak at 30 cm. in July, which proved to be Norwegian fat herring. In offshore waters off the NW.-coast (area W, Figure 1) the stock is composed of big herrings only. The herring caught by "Ægir" on the main fishing grounds (column E in Table 1), resembles very much the herring taken by the fishing vessels in August, but from column S it appears that north-coast herring are hardly present at all off the SW.- and S.-coast. The two last columns of the table show the size distribution of herring which were measured alive, when tagged. The taggings off the N.-coast took place in July, that of the SW.-coast in August and the areas of tagging are indicated by stippled lines on Figure 1. The size of the herring tagged off the N.-coast corresponds entirely with that of the herring caught in July and the same applies, but less pronounced, if the herring caught in the south

Table 2. Age of North Coast Herring in 1954.

Age	Year	NN	NS	ISPR	ISUM	¹⁾	Total
3	1951	—	—	4	—	—	2
4	1950	5	3	119	42	116	52
5	1949	3	—	515	409	51	214
6	1948	5	21	49	127	94	35
7	1947	24	89	10	56	72	34
8	1946	7	48	31	85	44	28
9	1945	36	72	226	197	139	127
10	1944	53	242	31	70	130	80
11	1943	88	218	4	14	29	70
12	1942	24	66	5	—	43	24
13	1941	40	61	—	—	61	29
14	1940	65	55	4	—	145	44
15	1939	102	20	1	—	43	45
16	1938	159	34	—	—	22	65
17	1937	197	41	—	—	11	78
18	1936	52	10	—	—	—	20
19	1935	63	13	—	—	—	24
20	1934	67	7	1	—	—	25
21	1933	7	—	—	—	—	3
22	1932	3	—	—	—	—	1
Total		1000	1000	1000	1000	1000	1000
Number		690	293	713	71	138	1905
²⁾		56	—	—	—	133	189
Grand Total		746	293	713	71	271	2094
^{0/100}		412	160	391	37	—	1000
Av. Age		14.9	11.1	6.2	6.7	—	10.7

¹⁾ Scales not fit for determination of type.

²⁾ Scales not fit for age reading.

(S) are compared with those tagged there (SW.-coast). It is noted that the tagged herring seem to be a little larger than the corresponding "caught" herring. The difference is due to the fact that the tagged herring were measured alive.

In Table 2 and Figure 3 a survey is given of the age composition of the herring from the commercial catches, by tribes. Twenty broods are represented (1932—1951) and the age ranges from 3 to 22 years. In the Northern Norwegian tribe (NN) we find the same dominating year-broods as last year (1934, 1937, 1938 and 1943) and in addition the year-brood from 1947 appears for the first time as a relatively rich brood. The average age in this tribe is 15 (14.9) years. In the Southern Norwegian tribe (NS) the same year-classes predominate with the exception of the oldest one (1934). The 1947 brood is considerably stronger than in NN and we note the 1944 brood as absolute dominant. The average age in this tribe is 11 (11.1) years.

Turning now to the Icelandic tribes there is not any similarity with the two just mentioned ones. The average age is between 6 and 7 years (6.2 and 6.7) and quite different year-classes are predominating. More than the half (515^{0/100})

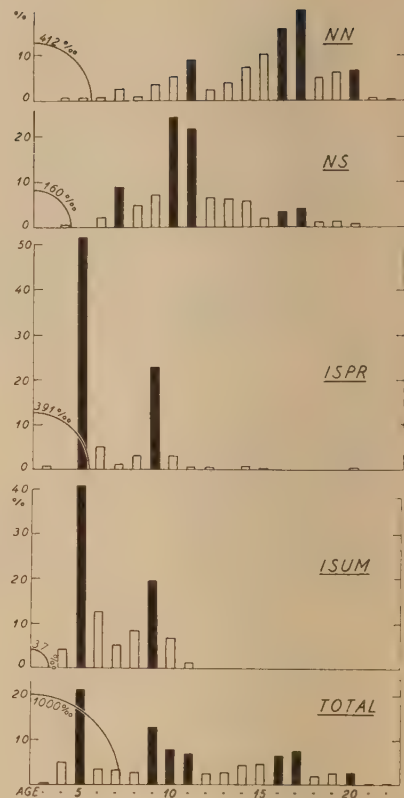


Figure 3. Age distribution in the different tribes of the north-coast herring 1954 and the relative number of fish in each tribe (circles at left).

NN = North Norway type.

NS = South Norway type.

ISPR = Icelandic spring spawners.

ISUM = Icelandic summer spawners.

of the spring-spawning stock (ISPR) is made out by the year-brood from 1949, accompanied by that of 1945 as a strong relative dominant. The same applies to the summer spawners (ISUM), but the predominance is not quite as pronounced as in the case of the spring-spawning tribe.

For comparison with 1952 and 1953 Figures 4 and 5 have been compiled. Taken as a whole the broods from 1934, 1937, 1938 and 1943 have been dominating in the Atlanto-Scandian tribes and those from 1940, 1945 and 1949 in the stock of Icelandic spring spawners. Only one year-brood has dominated all three years in the summer-spawning tribe.

At the bottom of Figure 3 and in the last column of Table 2 the age composition of the whole stock is recorded. There are many

dominants derived from the different tribes and it must be mentioned that the Atlanto-Scandian elements are much less predominating than in either 1952 or 1953, as will appear from the following figures ($^0_{/00}$):—

	NN	NS	ISPR	ISUM	Total
1952.....	666	156	94	84	1000
1953.....	565	175	171	89	1000
1954.....	412	160	391	37	1000

The main trend during this 3-year period has been that the relative number in the NN tribe has declined (by 38%) and the number in the ISPR has increased (by 316%). In 1952 the two international tribes made out 822 $^0_{/00}$ of the total catches their corresponding share in 1953 being 740 and in 1954 572 or just a little more than the half.

Table 3. The Total Number of Vertebrae (V.S.) in the different Tribes of the North Coast Herring in 1954.

V.S.	NN	NS	ISPR	ISUM	?	Total
59.....	12	5	12	1	4	34
58.....	214	69	228	13	58	582
57.....	422	175	418	43	155	1213
56.....	95	43	52	14	54	258
55.....	2	1	3	—	—	6
54.....	1	—	—	—	—	1
N.....	746	293	713	71	271	2094
M.....	57.18	57.12	57.27	57.01	57.04	57.18
± m.....	0.03	0.04	0.05	0.08	0.04	0.02

The number of vertebrae is shown in Table 3, where a survey is given for each tribe separately. The total number in the whole stock is again a little higher than in the previous year, being 57.18 as compared with 57.15 in 1953. This is mainly owing to a large increase in the number of vertebrae in the spring-

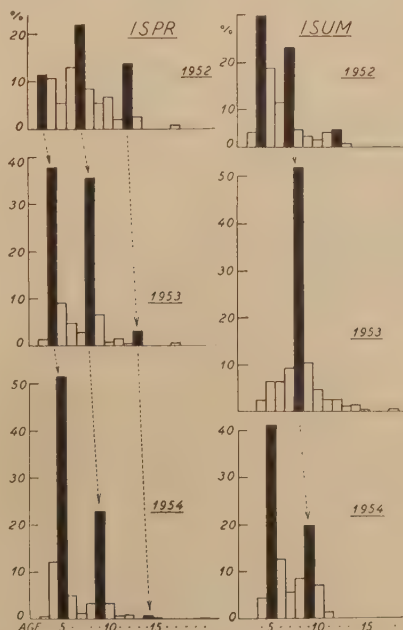
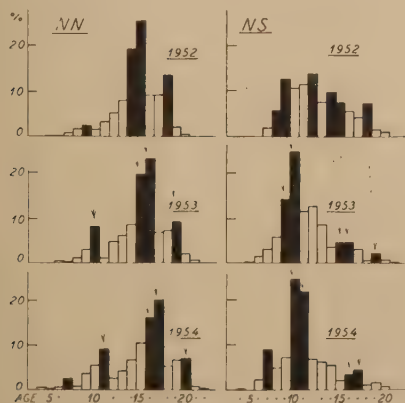
spawning Icelandic stock (ISPR). The following survey reveals the changes which have taken place within the various tribes during 1953—54:—

	NN	NS	ISPR	ISUM	Average
1952.....	57.17	57.12	57.14	56.89	57.13
1953.....	57.17	57.19	57.18	57.03	57.15
1954.....	57.18	57.12	57.27	57.01	57.18

The number of vertebrae, according to the stages of maturity, proved to be as follows:—

Stage	N	M	± m
II.....	171	57.28	0.04
III.....	542	57.23	0.03
IV.....	8	57.37	0.30
V.....	5	57.00	0.30
VI.....	—	—	—
VII.....	3	57.00	—
VIII....	1365	57.15	0.02
Total ...	2094	57.18	0.01

It appears that II and IV must represent Icelandic spring spawners and V and VII summer spawners. It is however most interesting to compare III and VIII as these two stages account for more than 91% of the total yields. It is evident that the number of vertebrae differs considerably although not significantly. This difference was found to be due to a relatively large number of Icelandic spring spawners in August in the III-group, which



Figures 4 and 5. The age composition of the north-coast herring by tribes during 1952—1954.

could only be explained by assuming that new "migrators" of this tribe came from the south at the same time as the Atlanto-Scandian tribes withdrew from the field.

The calculation of the maturity factor (MF) was carried out as in 1952 and 1953. It appeared to be a little lower now than before, 1.7 (%) in 1954, 2.3 in 1953 and 2.1 in 1952. The less advanced maturity was also reflected by the fact that relatively few herrings had surpassed a certain value of MF (5), namely 25⁰/₀₀ in 1954, 89 in 1953 and 34 in 1952. In good agreement with the slow advancement of maturity the index of intestinal fat was also somewhat lower (1.6) than in 1953 (1.7).

Fewer tags (121) were recorded than in 1953 (157). The records were these:—

From taggings in Iceland in	1948	1
— — — — —	1950	3
— — — — —	1951	2
— — — — —	1952	49
— — — — —	1953	42
— — — — —	1954	20
— — — — — Norway —	1948	1
— — — — —	1950	1
— — — — —	1951	2
Total.....		121

No tags from the S.- and SW.-coast were recorded.

ÁRNI FRÍÐRIKSSON.

North and North-East of the Faroe Islands. Occurrence of Herring.

As in previous years R/S "Dana" operated in the area north and north-east of the Faroes in the month of June, north to 66° N. Lat. and west of ca. 1° W. Long. The researches were carried out according to a general programme agreed upon by Denmark, Iceland and Norway. The hydrographical conditions and the distribution of the herring according to echo-

soundings in this area were examined and mapped (cf. Distant Northern Seas, section Hydrography, Figures 4-13). The main features were quite similar to those observed in the preceding years at the same season. As described in the hydrographic section the surface layers were however somewhat colder in the western and somewhat warmer in the eastern part of the area. Compared with preceding years the concentration of herring shoals was greater in the western boundary areas of the cold tongue and less in the eastern.

More detailed information on the position and catch of the Faroe herring fleet was collected in 1954. This information proves the movement of herring towards north in August and the first part of September, and the reverse migration later on in the season, resulting, in October, in dense concentrations of herring between 63 and 65° N. and 4 to 8° W., previously reported (cf. Ann. Biol., 10, p. 147).

The Faroe herring fishery in the area is increasing; in 1952 about 25 Faroe vessels took about 35,000 barrels, in 1953 89 vessels took 140,450 barrels, and in 1954 137 vessels took about 230,000 barrels.

Å. VEDEL TÅNING.

Norwegian Sea.

Routine work was carried out in 1954 on the same scale as during recent years. Figure 6 gives the age distribution of the herring in the various samples during the winter season. *Large Herring* include all herring secured in the Norwegian coastal area north of Bergen. *Spring Herring* include herring caught farther south off the coast.

Herring hatched in 1950 seem to constitute a very strong year-class. The young year-classes are as usual dominating the spring herring. The material illustrating the age distribution is

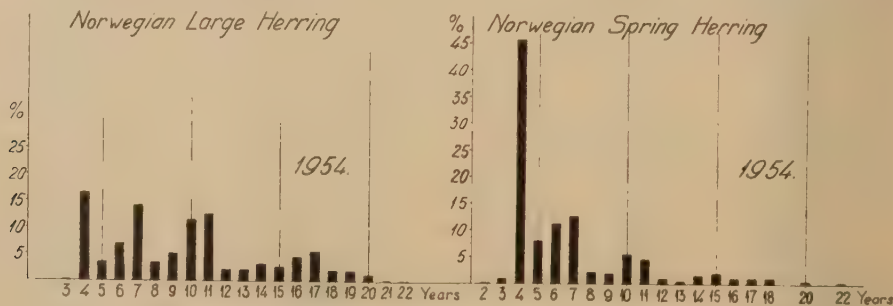


Figure 6. Age composition of the Norwegian winter herring.

composed of about 5400 large herring and 1200 spring herring.

Figure 7 gives the age composition of the samples from the Norwegian Sea caught on the cruises by "G. O. Sars". The black portion of the columns denotes herring belonging to foreign tribes, the open portion, those belonging to the Norwegian tribe of herring, according to analysis carried out by TH. RASMUSSEN. The different samples show a varying picture as regards age composition, but when all samples are added, we get a fairly good agreement with the large herring shown in Figure 6.

In January 1954 we also succeeded in following the herring from the area north of the Faroe Islands to the Norwegian coast. On this occasion the Norwegian fishermen were informed of the position, and of the approach of the herring shoals from day to day. After the start of the herring fishery and after the fishermen had obtained good contact with the herring in the Norwegian coastal waters, the "G. O. Sars" made a cruise in the Norwegian Sea and was able to locate many new shoals along the migration route till about 300 miles off the Møre coast.

In the area between the Faroe Islands and the Shetlands we also tried to investigate if any shoals penetrated the Atlantic water in this area, but bad weather in the latter part of January made any real investigation impossible.

The first fortnight of February was spent in trying to follow the herring to the so-called Spring Herring District, i.e., the coastal area south of Bergen. We could only find herring shoals in the coastal water. The shoals seemed to move southwards at a speed of about 15 nautical miles a day. The suggestion (see Ann. Biol. 1952) that the herring should cross the North Sea banks before arrival to the Spring Herring District therefore looks less likely.

During the summer of 1954, two cruises were made by the "G. O. Sars". During the first cruise, with Dr. EGGVIN in charge, a large material of hydrographic data was collected in collaboration with the Danish and Icelandic research vessels. The ships met in Thorshavn on 25. June in order to exchange observations. Maps of temperature conditions and of the location of herring shoals were prepared and distributed among the fishermen. On the second cruise in July—August, with DEVOLD in charge, additional hydrographic observations were made. Herring shoals were located and infor-

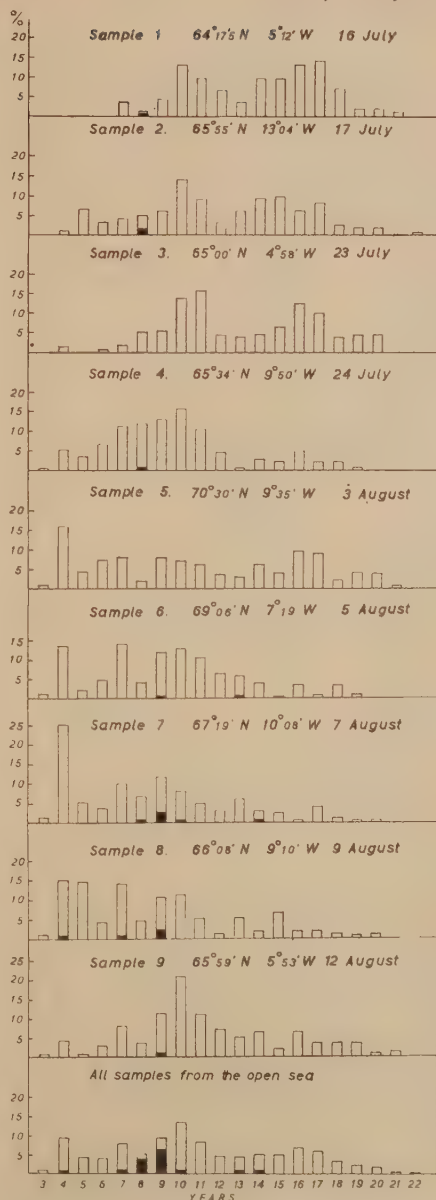


Figure 7. Age composition of samples from the open sea.

mation about their position were broadcast three times daily to the Norwegian fishing fleet. A skilled purse-seine operator had been hired for the cruise, and he succeeded in catching "invisible" herring shoals with the purse-seine in the open ocean, that is, shoals which had been located by means of Asdic.

In November and December the hydrogra-

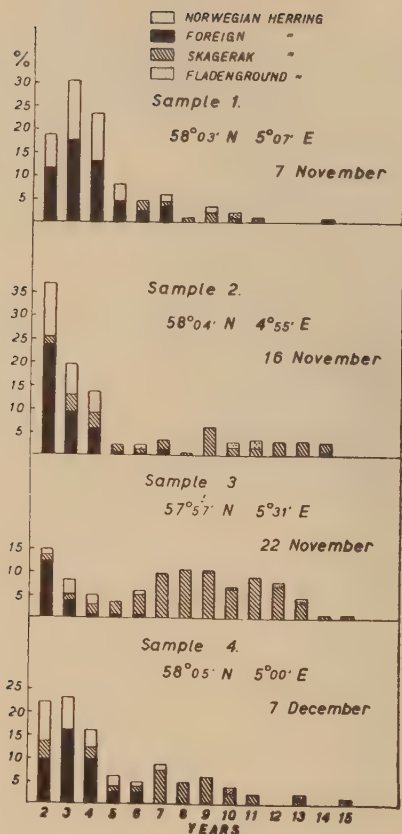


Figure 8. Age composition of samples from the North Sea slope, SW. of Egersund.

phic conditions were investigated along the slope of the North Sea plateau towards the Norwegian Channel. Fairly large concentrations of herring mixed with mackerel were found here during autumn and winter, and drift-nets gave good catches. The age composition of the herring samples taken by drift-nets are shown in Figure 8. According to analysis by TH. RASMUSSEN, the samples mainly contain spring-spawning North Sea herring indicated by the black portion of the columns. This herring has been described by K. A. ANDERSSON (Ann. Biol. 1948). The Norwegian tribe of herring demonstrated by the open portion of the columns, is abundant among the younger year-classes.

In December hydrographic investigations were carried out to north of the Faroe Islands. Also this winter, the herring was located in the cold water of the East Icelandic Arctic Current.

FINN DEVOLD.

Tagging Experiments.

The herring tagging work in Norway was continued in 1954 and extended to the fat herring in southern Norway. The numbers tagged in 1954 (38,827) are listed in Table 4 and they bring the total numbers of herring tagged by Iceland and Norway to 218,311 since 1948.

Table 4. Recoveries in Norway 1954.

Tagging Area ¹⁾	Year	Tagged Nos.	Type of Tag	Rec. 1954	% Rec.
Norway..... A	1948	6018	Internal	17	0.28
Iceland..... B	1948	7475	—	12	0.16
Norway..... A	1949	8261	—	46	0.56
Norway..... C	1950	9085	—	21	0.23
Norway..... A	1950	11215	—	13	0.12
Norwegian Sea. D	1950	506	—	2	0.40
Iceland..... B	1950	1321	—	13	0.98
Norway..... C	1951	10241	—	35	0.34
Norway..... A	1951	9986	—	75	0.75
		355	Int. and Ext.	0	0.00
		644	External	0	0.00
Norwegian Sea. D	1951	2012	Internal	40	1.99
Iceland..... B	1951	3064	—	56	1.83
Norway..... C	1952	10295	—	27	0.26
Norway..... A	1952	10863	—	120	1.10
		898	Int. and Ext.	11	1.23
		397	External	6	1.51
Norway..... E	1952	7971	Internal	15	0.19
		400	External	1	0.25
Iceland..... B	1952	17308	Internal	349	2.02
Norway..... C	1953	10079	—	19	0.19
		999	Int. and Ext.	6	0.60
Norway..... A	1953	10046	Internal	41	0.41
		900	Int. and Ext.	8	0.89
		200	External	1	0.50
Norway..... E	1953	8550	Internal	1	0.01
		260	Int. and Ext.	1	0.39
		1000	External	1	0.10
Iceland..... B	1953	15273	Internal	304	1.99
Norway..... C	1954	10042	—	109	1.09
		1000	Int. and Ext.	15	1.50
		200	External	0	0.00
Norway..... A	1954	10291	Internal	54	0.53
		950	Int. and Ext.	8	0.84
		250	External	3	1.20
Norway..... E	1954	15067	Internal	510	3.39
		677	Int. and Ext.	6	0.89
		450	External	8	1.78
Iceland..... B	1954	13762	Internal	0	0.00
Total.....		218311			

¹⁾

A = Spring herring

B = North coast herring

C = Large herring

D = Oceanic herring

E = Fat herring

On the tagging cruises to the large herring and spring herring districts both internal and external tags were used, as well as a combination of the two. The number tagged in each category will be found in Table 4. A "tagging gun" was used for inserting the internal tags.

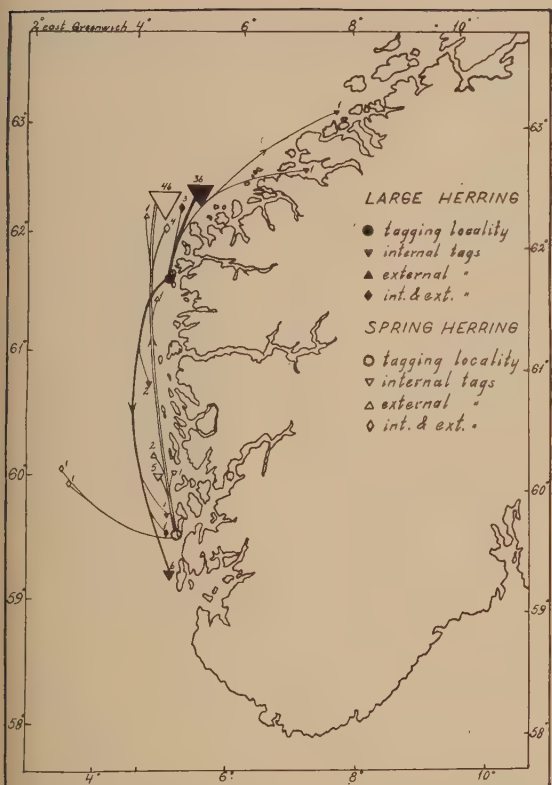


Figure 9. Recoveries in 1954 of large herring tagged from 30. January to 13. February and spring herring tagged from 6. to 18. March 1954. For explanation of the symbols see the text.

The taggings in the fat herring district were carried out at five localities between Florö and Kopangen, in Troms. The types of tags were the same as before. A report on tagging experiments conducted in collaboration with Iceland is in press (AASEN and FRIDRIKSSON). In Table 4 a survey of the returns from the different taggings will be found. It may be seen that a total of 1954 tags was recovered in the year 1954, a return of 0.90%. It must be remembered, however, that many of these herring have spent up to 6 years in the sea since tagging. The number of tagged herring present may therefore be expected to be substantially reduced. The latest extensive tagging in Iceland was carried out after the close of the winter herring fishery in Norway, and consequently could not possibly contribute any returns.

In Figure 9 the distribution of the recoveries in 1954 of the large herring and spring herring tagged that year is given. The number of her-

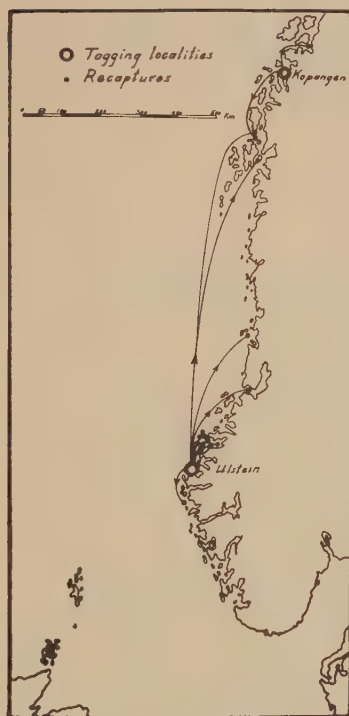


Figure 10. Recoveries in 1954 of fat herring tagged from 4. May to 13. July 1954.

ring recaptured in each locality is indicated with the symbols for recaptures, and the area of the triangles is proportional to the number of recoveries. Fifty-four herring recovered near the tagging site and 19 recaptures of uncertain location are not shown. As will be noted, there is a spreading both north and south, but most of the tagged herring were recovered between Florø and Ålesund. Only three of the tagged spring herring were recaptured at the tagging locality, and the positions of two recaptures are uncertain.

The main migration routes for the spring herring tagged are: northwards along the Norwegian coast, and westwards towards Shetland. No fish were recovered in the North Sea or the Skagerak.

In Figure 10 some of the most interesting recoveries of fat herring tagged in the summer that year are shown. Only two of the tagging sites are shown, Ulstein and Kopangen. The tagging in Ulstein was conducted from the 5. May to the 4. June, and in Kopangen from the 10. to 13. July.

Black circles indicate the recaptures. It will be noticed that there is a general migration in a northern direction by the herring tagged in Ulstein during the summer and early autumn.

The tagging in Kopangen has given few recoveries. These show a movement from the tagging place both north and south along the coast.

OLAV DRAGESUND.

B. North Sea and Adjacent Waters.

YOUNG STAGES

Autumn-Spawned Herring Larvae in the Northern North Sea.

Scottish sampling of autumn-spawned herring larvae in 1954 was restricted to the region between 57°00' and 59°45'N. and between the Scottish coast and the prime meridian. This was planned to provide more intensive sampling of that portion of the larvae spawned in Scottish waters which is likely to provide recruitment to the "halflin fishery" in the upper reaches of the Moray Firth. The area was sampled during the following periods:—7.—18. August, 4.—11. September, 29. October—2. November and 7.—17. November.

During the August cruise herring larvae were extremely scarce and were largely restricted to a region to the west of Orkney and off Noss Head (Caithness). By the time of the September cruise herring larvae were abundant. The smallest were concentrated off (a) Start Point (NE. Orkney); (b) in an extensive area extending from the west of Hoy, (Orkney), through the Pentland Firth northwards to the Copinsay grounds, and southwards over Smith Bank; and (c) over Turbot Bank. As in previous years the latter area contained the densest concentration of newly hatched larvae. By the time of the October cruise larvae of less than 10 mm. were again extremely sparse.

The September and October cruises were too widely separated to allow a confident statement to be made concerning the subsequent fate of these September concentrations of early larvae. The probability is that the Turbot Bank larvae, as in previous years, were drifted in a southerly direction out of the survey area, whilst those from the Orkney spawning grounds were dispersed in a south-easterly direction over the whole of the Moray Firth and even to the grounds off the Aberdeenshire coast.

In September 1954 the abundance of herring larvae was less than half that attained within the same area in the corresponding

cruise in the previous year. This may have been at least partly due to the fact that the 1954 cruise in this month took place somewhat earlier and so may have preceded the hatching peak. On the subsequent cruises, however, the abundance of larvae in 1954 was about twice that attained in the previous year. Although this may have been in some part due to an overall higher initial production of larvae, it can largely be accounted for by the lower coefficient of mortality (ca. 2.5% per day) in the 1954 season.

A. SAVILLE.

0- and I-Group, Scotland 1953—54.

A successful drift-net fishery for "halflin" herring was carried out in the upper reaches of the Moray Firth from September 1953 to March 1954. The average catch per landing was maintained at 23 crans, but the total catch

Table 5. Length and Mean Vert. S. of 0- and I-Group Herring caught in the Inshore Waters off the Scottish East Coast in 1953—54.

(Numbers in brackets)				
Locality	Date	Range cm.	Mean Length cm.	Mean Vert. S.
Autumn 1952 and Spring 1953 Broods				
Firth of	Jan. 1954 ²	10—16	13.53 (190)	56.51 (100)
Forth	Mar. 1954 ²	10—18	14.54 (205)	56.57 (202)
St. Andrews	Feb. 1954	11—15	13.53 (40)	56.63 (38)
Bay	Apr. 1954	7—11	9.32 (68)	56.62 (63)
Inverness	Dec. 1953 ¹	7—14	10.21 (117)	56.59 (110)
Firth	Mar. 1954 ¹	10—16	13.84 (89)	56.54 (81)
	Mar. 1954	10—16	13.53 (103)	56.69 (103)
Autumn 1951 and Spring 1952 Broods				
Firth of	Nov. 1953 ²	17—23	20.12 (41)	56.44 (39)
Forth	Jan. 1954 ²	18—25	21.70 (102)	56.51 (98)
	Feb. 1954 ²	19—24	21.81 (168)	56.50 (163)
	Mar. 1954 ²	18—24	20.80 (30)	56.53 (30)
St. Andrews	Mar. 1954 ²	21—25	22.32 (96)	56.48 (95)
Bay	Apr. 1954	18—24	20.96 (139)	56.45 (127)
Inverness	Nov. 1953 ²	18—23	20.58 (228)	56.49 (221)
Firth	Nov. 1953 ²	20—23	21.61 (106)	56.60 (103)
	Dec. 1953 ¹	18—24	20.88 (128)	56.47 (123)
	Dec. 1953 ²	17—23	19.85 (205)	56.39 (195)
	Jan. 1954 ²	19—25	22.13 (169)	56.54 (164)
	Mar. 1954 ¹	16—23	19.18 (99)	56.53 (95)

¹) "Explosion" samples.

²) Drift-net samples.

²) Ring-net samples.

All others caught by trawl.

of 61,773 crans landed by an increased fleet was almost double that of the previous year (Ann. Biol., 10, p. 152).

Ring-net vessels worked in the upper reaches of the Firth of Forth from September 1953 to April 1954 on a mixed population of sprats, 0-group and "halfin" herring. Large shoals of sprats and 0-group herring but very few "halfins" were present on these grounds up to the end of December. Thereafter good catches of both were landed. During February and March 1954 some vessels made landings of "halfins" and mixed small fish from the outer waters of the Firth of Forth and from St. Andrews Bay. This was the first season since the war in which any quantity of herring, other than 0-group, had been located in the outer waters of the Firth of Forth or in St. Andrews Bay. The majority, however, had the characteristics of an autumn-spawning type.

Samples of 0- and I-group herring from the commercial fisheries in the Moray Firth and Firth of Forth were examined, and samples were also obtained by research vessels using trawl and drift-nets and explosive charges. Details of the material examined are given in Table 5. The contribution made by spring-spawned herring to both 0- and I-group catches was relatively small.

G. McPHERSON.

English East Coast.

0-group herring.

Investigations on the 0-group herring found along the English east coast were continued during 1954. While most of the samples were obtained with the beach seine, a few came from the catches made by bottom trawls with a cover on the cod-end. Many of the samples had a bi-modal length distribution, and although these usually appeared to be composed of two broods only, in a few samples three broods could be detected. Vertebrae counts were normally only made on samples containing more than one brood, if the length distribution was such that very little overlapping was indicated. These were split in the same manner as those examined by Wood (Ann. Biol., 10, p. 153). exceptions are discussed in the following paragraphs.

A small catch was made on Scroby Sands off Great Yarmouth on 30. XII. 53, but 0-group herring were not captured with the beach seine at Lowestoft until 29. April 1954, the total being 79 in five hauls. By 27. May, however,

Table 6. Mablethorpe. 13—8—54. Beach Seine.

Length cm.	Frequency	Number of Vertebrae							
		53	54	55	56	57	58	59	
3.0—4.....	1	—	—	—	—	—	—	—	
.5—9.....	56	—	5	6	4	—	—	—	
4.0—4.....	114	1	11	21	10	—	—	—	
.5—9.....	42	—	8	14	10	—	—	—	
5.0—4.....	12	—	3	3	3	1	—	—	
.5—9.....	—	—	—	—	—	—	—	—	
6.0—4.....	4	—	—	—	1	2	1	—	
.5—9.....	23	—	—	—	13	9	1	—	
7.0—4.....	29	—	—	1	12	13	3	—	
.5—9.....	44	—	—	2	9	25	5	1	
8.0—4.....	11	—	—	1	2	7	1	—	
.5—9.....	2	—	—	—	1	—	1	—	
cm.	{ M = 55.000 σ = 0.7914 σ _m = 0.0791		cm.	{ M = 56.589 σ = 0.6815 σ _m = 0.0911					
3.5—5.4			6.0—7.4						
cm.	{ M = 56.712 σ = 0.7433 σ _m = 0.0705		cm.	{ M = 56.836 σ = 0.7880 σ _m = 0.1063					
6.0—8.9			7.5—8.9						

the number had increased to about 500 per haul.

Extensive sampling was carried out during May, which revealed the presence of at least three herring broods between Amble and Lowestoft, the modal lengths being approximately in the region of 4, 5, and 6 cm. The distribution and details of these herring are given in Table 7. During the May investigations small numbers of herring larvae were caught with the Petersen young-fish-trawl in the coastal waters between Amble and Lowestoft. Only one 0-group herring which had metamorphosed was included in these catches although herring and sprats as large as 17 cm. were taken at several stations.

Further sampling carried out in July and August between Blyth and Orford Ness, revealed an additional brood along the NE. coast. These herring were obviously spring spawned, mean Vert. S. being 57.059 and modal length 4 cm. The larger brood found in this area during May was missing from these later samples. The unusual 0-group herring discovered during 1953 were almost entirely missing from the East Anglian coasts, but one sample, given in detail in Table 6, was obtained from Mablethorpe on the Lincolnshire coast on 13. August having the very low mean Vert. S. 55.000.

Hauls were made with the Petersen young-fish-trawl during August in the coastal waters between Mablethorpe and Orford Ness. Small numbers of 0-group herring larger than 5.4 cm. were captured off the East Anglian coast, up to a distance of 3 miles.

Table 7.
Samples of 0-Group Herring from the English East Coast and Southern North Sea in 1954.

Locality	Date	Gear	Length Range A. cm.	Calculated Modal Lengths, cm.	Length Range B. cm.	Mean Vert. S. (nos. in brackets)	Standard Deviation	Standard Deviation of the Mean
Scroby Sands	30—12—53	B.S.	3.0—6.4	4.32	3.0—6.4	56.623 (61)	0.6368	0.0815
Botney Gut...	21—3—54	T.	10.0—17.9	12.00	10.0—13.4	56.613 (119)	0.6392	0.0586
				14.25	13.5—14.9	56.410 (39)	0.5946	0.0952
				15.68	15.0—16.4	56.750 (12)	—	—
Lowestoft....	29—4—54	B.S.	3.0—5.4	4.06	3.0—5.4	56.696 (79)	0.6476	0.0729
Amble.....	11—5—54	B.S.	4.0—5.5	4.72	4.0—5.5	56.550 (100)	0.5925	0.0593
Sunderland...	13—5—54	B.S.	4.0—9.4	6.49	—	—	—	—
Hartlepool...	14—5—54	B.S.	4.0—7.4	4.70	—	—	—	—
Scarborough...	15—5—54	B.S.	4.5—7.9	6.05	5.0—6.9	56.590 (100)	0.6372	0.0637
Scarborough...	17—5—54	B.S.	4.0—7.9	4.74	4.0—5.4	56.567 (60)	0.7217	0.0932
				6.50	5.5—7.9	56.510 (100)	0.5945	0.0595
Bridlington...	20—5—54	B.S.	3.0—9.9	5.94	4.5—7.9	56.481 (106)	0.5892	0.0572
Spurn Point...	23—5—54	B.S.	3.5—6.9	4.30	—	—	—	—
Lowestoft....	27—5—54	B.S.	3.0—6.0	4.17	3.0—5.4	56.700 (100)	0.6113	0.0611
Scroby Sands	4—6—54	B.S.	4.5—9.4	7.73	6.5—9.4	56.460 (100)	0.6423	0.0642
Lowestoft....	3—7—54	B.S.	3.5—10.9	5.64	4.0—6.9	56.978 (137)	0.7221	0.0617
				7.93	—	—	—	—
Blyth.....	21—7—54	B.S.	3.0—8.4	3.99	3.0—5.4	57.059 (102)	0.7011	0.0694
				6.29	5.5—7.9	56.626 (115)	0.6136	0.0572
Sunderland...	22—7—54	B.S.	3.5—9.4	3.93	—	—	—	—
				7.06	6.0—7.9	56.590 (100)	0.6831	0.0683
Hartlepool...	22—7—54	B.S.	3.5—9.9	4.14	—	—	—	—
				6.62	—	—	—	—
Scarborough...	24—7—54	B.S.	3.5—9.9	6.83	5.0—7.4	56.510 (104)	0.6231	0.0611
				8.17	7.5—9.4	56.698 (53)	0.7490	0.1029
Bridlington...	25—7—54	B.S.	3.5—9.4	6.03	5.0—7.4	56.521 (144)	0.6142	0.0512
				8.14	7.9—8.9	56.750 (64)	0.6666	0.0833
Lowestoft....	5—8—54	B.S.	3.5—8.9	6.17	5.0—8.4	56.980 (100)	0.6813	0.0681
Skegness....	13—8—54	B.S.	3.0—13.4	8.10	7.0—8.9	56.910 (100)	0.6528	0.0653
Mablethorpe..	13—8—54	B.S.	3.0—8.9	4.20	3.0—5.4	55.000 (100)	0.7914	0.0791
				7.43	6.0—8.9	56.712 (111)	0.7433	0.0705
Orford Ness...	17—8—54	B.S.	5.5—8.4	7.24	6.0—8.4	56.960 (100)	0.7095	0.0710
Lowestoft....	19—8—54	B.S.	4.5—11.4	6.52	—	—	—	—
Lowestoft....	21—10—54	B.S.	5.0—9.9	6.99	5.5—8.4	56.920 (100)	0.7203	0.0720
15°N.E. of								
Hartlepool...	24—11—54	T.	10.0—12.9	11.30	10.0—12.9	57.074 (27)	0.6751	0.1299
Lowestoft....	18—12—54	B.S.	6.0—11.4	7.15	6.0—9.0	56.921 (38)	—	—
Botney Gut...	1—1—55	T.	12.5—17.4	14.04	12.5—15.4	56.648 (54)	0.6773	0.0922

Length Range A = Total catch 0-group.

Length Range B = Sample on which vertebral counts were made.

Gear: B.S. = Beach Seine.

T. = Trawl.

The most interesting feature of the 1954 investigation was the exceptionally high mean Vert.S. of the herring sampled at Lowestoft from 3. July onwards, and also at Skegness on 13. August and Orford Ness on 17. August. In each sample mean Vert.S. was over 56.9, although the modal lengths varied considerably with locality.

The 0-group herring found along the Suffolk coast are usually associated with the winter spawning at Sandettié and the eastern end of the English Channel, and from these investigations it appears that an unusually high mean Vert.S. was a characteristic of the 1953—1954 winter spawning in that region.

The sample at Lowestoft on 3. July is given in detail in Table 8. The length distribution was most unusual and it is clear that the vertebral counts are high in herring from 4 to 8 cm. in length. Apart from this one sample all the others at Lowestoft during 1954 were unimodal and had a normal length distribution. The modal lengths indicate that in 1954, 0-group herring caught at Lowestoft (except on 3. July) originated from the latter part of the winter spawning, whilst many of those caught on 3. July, and at Skegness on 13. August, must have been spawned several weeks earlier.

HODGSON (Fish. Invest., Ser. 2, 11, 7, p. 65)

Table 8. Lowestoft. 3.—7.—54. Beach Seine.

Length cm.	Frequency	Number of Vertebrae			
		55	56	57	58
3.5—9.....	1	—	—	—	—
4.0—4.....	6	1	1	1	—
4.5—9.....	46	1	1	9	2
5.0—4.....	111	—	4	27	6
5.5—9.....	107	1	8	15	11
6.0—4.....	76	1	5	15	6
6.5—9.....	50	—	5	14	2
7.0—4.....	44	—	7	15	4
7.5—9.....	28	2	9	15	2
8.0—4.....	33	2	10	15	4
8.5—9.....	10	1	5	4	—
9.0—4.....	7	—	4	2	—
9.5—9.....	2	—	2	—	—
10.0—4.....	2	—	1	1	—
10.5—9.....	1	—	—	—	—

cm. $\left\{ \begin{array}{l} M = 56.978 \\ \sigma = 0.7221 \\ \sigma_m = 0.0617 \end{array} \right.$
4.0—6.9

found 0-group herring of very similar mean Vert.S. distributed along the English east coast in 1928, from the Thames Estuary to Bridlington. It is therefore most likely that in the sample from Bridlington on 27. July, the larger brood was composed mainly of herring from the winter spawning. The mean Vert.S. 56.750 is high even though there was a certain amount of overlapping, with the smaller brood, mean Vert.S. 56.521. Table 9 shows that there is also a similarity in the distribution of vertebral counts with the samples further south having high mean vertebral numbers. The smaller brood in the Bridlington sample has a significantly different mean vertebral number to the Lowestoft sample of 5. August, although the modal lengths are similar.

The two broods in the Bridlington sample were also present in the Mablethorpe sample on 13. August. Table 6 shows this quite clearly although there was considerable overlapping. It is possible that the Scarborough sample on 24. July may have contained the same two broods, but in this sample too there was overlapping and the mean Vert.S. 56.698 of the larger brood gives no real clue as to its origin.

Of the trawl samples, the one from Botney Gut on 21. III. 54 is of most interest, as it was caught at the end of the winter. There were three modes in this sample, at 12.00, 14.25 and 15.68 cm. It is felt that although there is considerable overlapping, the mean vertebral numbers of the 3 groups as given in Table 6, are of more value than if only one mean is calculated for the complete sample.

R. J. WOOD.

Table 9.

Lowestoft. 29.—4.—54			Lowestoft. 27.—5.—54		
3.0—5.4 cm.			3.0—5.4 cm.		
55	3		55	2	
56	23	M = 56.696	56	32	M = 56.700
57	48	$\sigma = 0.6476$	57	60	$\sigma = 0.6113$
58	5	$\sigma_m = 0.0729$	58	6	$\sigma_m = 0.0611$
79			100		
Lowestoft. 3.—7.—54			Lowestoft. 5.—8.—54		
4.0—6.9 cm.			5.0—8.4 cm.		
55	4		55	1	
56	24	M = 56.978	56	20	M = 56.980
57	81	$\sigma = 0.7221$	57	60	$\sigma = 0.6813$
58	27	$\sigma_m = 0.0617$	58	18	$\sigma_m = 0.0681$
59	1		59	1	
137			100		
Lowestoft. 21.—10.—54			Scarborough. 24.—7.—54		
5.5—8.4 cm.			7.5—9.4 cm.		
55	3		55	2	
56	21	M = 56.920	56	19	M = 56.698
57	57	$\sigma = 0.7203$	57	25	$\sigma = 0.7490$
58	19	$\sigma_m = 0.0720$	58	7	$\sigma_m = 0.1029$
100			53		
Bridlington. 25.—7.—54			Mablethorpe. 13.—8.—54		
7.9—8.9 cm.			7.5—8.9 cm.		
55	2	M = 56.750	55	3	M = 56.836
56	18	$\sigma = 0.6666$	56	12	$\sigma = 0.7880$
57	38	$\sigma_m = 0.0833$	57	32	$\sigma_m = 0.1063$
58	6		58	7	
64			59	1	
			55		
Skegness. 13.—8.—54			Orford Ness. 17.—8.—54		
7.0—8.9 cm.			6.0—8.4 cm.		
55	1		55	2	
56	23	M = 56.910	56	20	M = 56.960
57	60	$\sigma = 0.6528$	57	59	$\sigma = 0.7095$
58	16	$\sigma_m = 0.0653$	58	18	$\sigma_m = 0.0710$
59	1		59	1	
100			100		

COMMERCIAL FISH

Young Herring from the Bløden Ground Area.

During 1954 further investigations on the herring and the herring fishery of the Bløden area were carried forth along the lines of research adopted in 1953.

The yield of the fishery amounted to 64.1 mill. kg.¹) (15.1 mill. kg. in the spring season against 49.0 mill. kg. in the summer/autumn season). The total catch thus exceeded 1953 with about 15 mill. kg. or 30.7%.

Table 10 shows the results of analyses of samples mainly obtained from commercial

¹) Including small amounts of whiting.

Table 10.

Herring Samples from the Bløden Ground Fishery 1954 analysed for Meristic Characters.

Date	Total no.	%	1951 Year-class			%	1952 Year-class		
			Av. Size	Av. K_2	Av. V.S.		Av. Size	Av. K_2	Av. V.S.
6/2.....	164	27.5	19.93	14.88	56.59	68.1	14.79	14.69	56.50
17—18/2.....	185	34.7	19.78	15.13	56.74	62.0	16.27	14.86	56.42
23—28/2.....	141	46.1	20.13	14.88	56.52	50.2	16.14	14.78	56.59
1—6/3.....	150	3.8	—	—	—	96.2	15.95	14.88	56.52
18—28/3.....	112	38.4	20.08	14.82	56.60	32.0	15.80	14.77	56.69
24/3.....	110	41.5	19.78	14.80	56.51	55.7	15.98	14.89	56.52
5—12/4.....	191	5.4	19.50	14.95	56.40	93.8	15.64	14.72	56.53
9/5.....	134	—	—	—	—	100.0	15.45	14.44	56.58
8/8.....	169	—	—	—	—	99.8	18.04	14.78	56.48
11/9.....	150	9.3	24.00	15.14	56.69	90.7	20.65	14.90	56.59
12/9.....	148	10.5	23.88	15.06	56.44	86.8	21.14	14.66	56.69
12/9.....	56	sorted	—	15.09	56.43	—	—	—	—
15/9.....	184	23.7	23.41	14.83	56.73	73.1	20.62	14.65	56.59
22/9.....	149	10.0	24.16	14.86	56.53	89.3	20.69	14.75	56.44
22/9.....	150	24.5	23.71	15.06	56.74	72.3	21.13	14.65	56.33
23/11.....	115	—	—	—	—	95.0	21.07	14.71	56.66

catches during the spring and from research trawlings during the autumn. The age composition of the spring stock differed somewhat from that observed in previous years. Whereas the II-group has been dominating the catches during the period 1951—53, the I-group clearly made up the main bulk of the herring landed in the spring of 1954, being almost the sole constituent from late March to the end of the season in early May. This mass occurrence of I-group herring is in good accordance with the presence of unusual quantities of 0-group herring in the late autumn of 1953. During the autumn season of 1954 the average size of the herring was on the main somewhat bigger than in 1953, but the age composition agrees well with earlier observations—the I-group being by far the most important component. No 0-group herring were observed.

The meristic characters of the I-group (1952 year-class) are in agreement with those of the 1951 year-class during the fishery of 1953. If any tendency in the main distribution is present as compared with 1953, it is a minor decrease in V.S. values of the spring samples and a minor decrease in K_2 values of the autumn samples.

As to the origin of the young herring of Bløden Ground a detailed answer is not yet possible. The meristic characters alone are of little value as their distribution covers nearly all possibilities involving the autumn- and winter-spawning North Sea herring. However, in taking l_1 measurements into consideration, it seems possible to draw some preliminary conclusions. In about 1800 measurements on

material mainly collected during the autumn of 1953, we have compared the meristic characters of fishes having small l_1 's (10—11), with those of fishes having larger l_1 's (12—14). While difference in average V.S. (56.57 and 56.55, respectively) is insignificant the difference in K_2 means are clearly significant:—

l_1	Nos.	K_2	s
10—11	834	14.94	0.939
12—14	892	14.80	0.850

The high K_2 value of herring with smaller l_1 is usually connected with late autumn spawners of the western Dogger Bank (Oct.—Nov.). Winter spawners from the southernmost North Sea seem, according to their low K_2 and small l_1 , not to be mixed up to any noteworthy extent in the Bløden concentration. The l_1 -groups 12—14 are supposed to be early autumn spawners (Aug.—Sept.). We know such spawners with low K_2 and high V.S. from the Dogger Bank (vide p. 138) and with lower V.S. from the British east coast, and a mixture of both would seem to cover the observed variation in this group of the Bløden herrings in a satisfactory way. Of course a sharp distinction between early and late autumn spawners is impossible but for a rough picture. We believe, however, that according to the above stated it is reasonable to presume that the main bulk of the young herrings in the Bløden Ground area consists of autumn spawners from the central North Sea, partly from earlier spawnings in the northern Dogger region and along the Yorkshire coast and partly from the later

spawnings in the western region of the Dogger Bank and on the grounds south of the Silver Pit.

Still using the distinction between early (E.A.S.) and late (L.A.S.) autumn spawners the main components of the stock in each season may according to age-groups be depicted thus:—

	Spring season	Autumn season
0-group.....	absent	E.A.S.
I-group.....	E.A.S.	E.A.S. + L.A.S.
II-group.....	L.A.S.	L.A.S.

From this point of view the stock composition of 1954 would indicate, that the strength of the 1952 year-class is much above average concerning the earlier autumn spawnings, and that the 1953 year-class will be distinctly weaker, in accordance with the total lack of the 0-group herring in the autumn of 1954. A decline in the catches of the spring season of 1955 should be the result if this presumption is right. As to the autumn season a prediction of increasing or decreasing catches is more difficult. The smaller herrings of the 1953 year-class (later autumn-spawned) are the unknown factor in this connexion as they are still too small to show up in the spring fishery of 1955 let alone the autumn fishery of 1954 (specimens less than 12 cm. being extremely scarce in the commercial catches). Even if this part of the North Sea population may prove to be abundant, the probable scarcity of the earlier spawned autumn brood would eventually mean a lower total catch of the autumn season of 1955 compared with 1954.

E. BERTELSEN and K. POPP MADSEN.

Scottish Fisheries 1954.

A. North Sea.

Drift-net fishing in the North Sea in 1954 was pursued from the following Scottish ports:—Aberdeen (April to August), Peterhead and Fraserburgh (April to early September), and Lerwick (May—mid-August); sporadic landings were made in the period June to August at Wick. The fishing in April from Aberdeen and Peterhead took place in the north-eastern North Sea, but the fleets at both ports moved, along with the Fraserburgh fleet, to the more local grounds in the north-western North Sea in May. Thereafter the fishing followed the customary pattern on these grounds.

The landing statistics for these fisheries in 1954 are given in Table 11, together with the landings of trawled herring at Aberdeen from the Fladen and "Gut" trawling grounds in the period July to October. Of these, only 240 crans were caught by Scottish vessels, the remainder being landed periodically by foreign vessels, principally Swedish.

Landings at the two major drift-net ports Fraserburgh and Peterhead were lower in 1954 than in the two previous peak fishing years, 1952 and 1953 due, mainly, to a reduction in fishing effort. The figures derived from the catch per unit effort show that the available stock on the grounds was of about the same density as that fished in the peak years, especially in June and July when the highest average yields were obtained. The fishery at Shetland in 1954 was only slightly better than that of the very poor 1953 season. High

Table 11. East Coast and Shetland Herring Landings.

	Drift Net.								Average catch per arrival ¹⁾			
	Landings (crans)				Arrivals				(crans)			
	1951	1952	1953	1954	1951	1952	1953	1954	1951	1952	1953	1954
Fraserburgh.....	95,073	188,207	213,285	147,817	7907	8468	9790	6630	12.0	22.2	21.8	22.3
Peterhead.....	42,581	106,405	124,762	87,218	3081	4072	4899	3570	13.8	26.1	25.5	24.4
Lerwick.....	31,463	49,180	15,666	23,382	1916	2415	1345	1664	16.4	20.4	11.6	14.1
Wick.....	22,122	5,994	5,345	4,894	910	194	387	242	24.3	30.9	13.8	20.2
Aberdeen.....	31,218	62,274	72,217	61,499	665	915	1183	1000	46.9	68.1	61.0	61.5

Trawl (Aberdeen and Foreign vessels combined)												
	Landings (crans)				Hours fishing				Landings per 100 hours			
	1951	1952	1953	1954	1951	1952	1953	1954	(crans)	1951	1952	1953
Fladen.....	16,425	18,983	8,950	3,869	7,111	9,773	3,382	1,502	231.0	194.2	264.6	257.6
Gut and Southwards....	—	5,043	8,976	12,057	—	1,363	2,391	2,871	—	370.0	375.4	420.0

¹⁾ These figures are not adjusted to 100 nets per haul. Each arrival at Aberdeen represents, on average, 2 hauls. Arrivals at all other ports usually only one haul.

April

May

June



Charts 1—3.

July

August

September

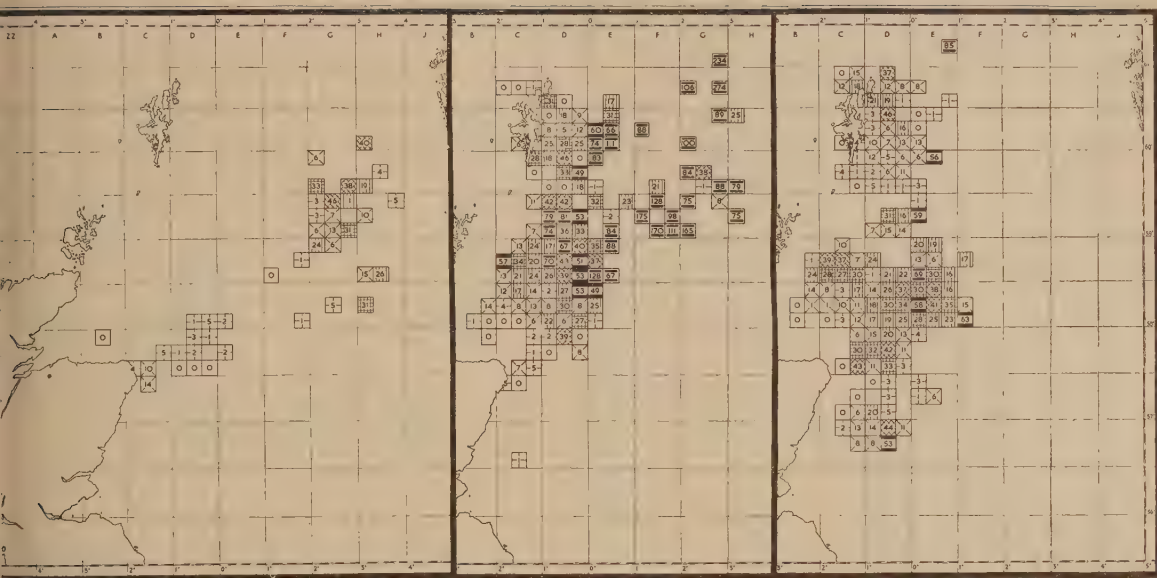


Charts 4—6.

April

May

June



arts 7—9.

July

August

September



arts 10—12.

catches were made in this area in May, but the fishery declined sharply in early June and failed to recover before its closure in mid-August. The Aberdeen fishery, which exploited the same stocks as those fished at Fraserburgh and Peterhead, gave average yields comparable with the two preceding years.

There was a drop in the quantity of herring landed at Aberdeen from the Fladen area in 1954, but the quantity landed from the "Gut" and more southerly grounds increased sharply. The catch per unit effort for both areas indicates that stock densities were at least as great as in 1953.

The detailed statistics of catch and effort on a regional basis in each of the months April to September are given for the drift-net fisheries conducted from Fraserburgh, Peterhead and Lerwick, in Charts 1—12. Comparable statistics for the Aberdeen fishery are not available. Charts 1—6 record the number of hauls made in each "10 mile square" (10' latitude by 20' longitude), and Charts 7—12 give the corresponding average catches per 100 nets per haul in each square. The average catch, to the nearest cran, is stated for each square, and squares are also categorized in intervals corresponding, as in previous years, with those used in the published Dutch charts (Ann. Biol., 8—10).

The seasonal pattern of the fisheries in the north-western North Sea was approximately the same as in the two previous years. The most productive grounds in May and June were again more than 60 miles from the north-east coast ports, but as the season progressed the centre of abundance moved southwards and westwards to grounds within a 40 mile radius from the ports. Only in May were large catches made with some consistency on the local Shetland grounds. Thereafter the effort and the landings fell away to a very low level.

Length, Age, and Racial Composition of Samples.

North-eastern North Sea.

Three samples of herring were taken from drifters working in the north-eastern North Sea in April and May 1954. The length and age composition of these samples are presented in Figure 11 and their maturity and Vert. S. data are given in Table 12.

These samples showed a wide variation in age and spawning type composition. The April

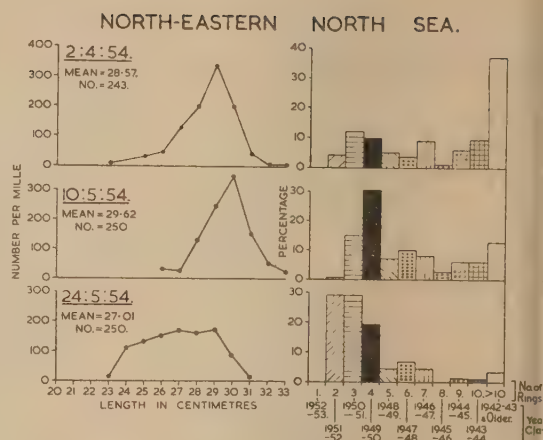


Figure 11. Length and age compositions of north-eastern North Sea drift-net samples, April—May 1954. (Length frequencies unsmoothed).

sample from the 'Utsire Patch' area was composed principally of old recovering spent autumn spawners. Otolith analysis showed that 85% of the total samples were of this type, the remainder being spring spawners in age-groups II—V, and maturity stages I, IV, VI and VII. Spring spawners were more prominent in the May samples, and the distribution of the two spawning types amongst the age-groups as determined from their otolith characters presented in Table 13.

The spring-spawning group were predominantly young herring and possessed characters similar to those of the spring group encountered in the Shetland area during the summer fishery. The composition of the autumn spawners were somewhat different in the two samples. Herring older than eight years of age predominated in the J. 19 sample, while the F. 17 sample was composed principally of younger age-groups. These age compositions show a marked resemblance to those of the autumn-spawning components of the stocks fished later in the summer at Shetland and off the north-east coast of Scotland respectively. These and earlier data (Ann. Biol., 10) indicate that major parts of the autumn- and spring-spawning stocks which invade the north-western North Sea in the summer months, do so from the eastern regions.

North-western North Sea.

Daily sampling was conducted throughout the fishing season at each of the major Scottish

Table 12. Maturity and Racial Characters—North-Eastern North Sea.

Date of capture 1954	Position in miles from Aberdeen	Statist. Square	A. Percentage Maturity (all Age-Groups)										B. Vert. S. (Actual Numbers — all Age-Groups)					
			Maturity Stage															
			I	II	III	IV	V	VI	VII and VII-II	No.								
2/4	194 E. × N. 1/2 N.	H. 16	6.2	2.1	1.7	2.5	—	9.5	78.2	243	55	56	57	58	59	Mean		
10/5	270 NE. × E.	J. 19	6.8	15.2	—	—	—	0.8	77.2	250	10	85	115	24	1	56.66		
24/5	167 NE. × E.	F. 17	37.6	26.8	—	—	—	—	35.6	250	9	82	128	30	—	56.72		
											6	90	132	22	—	56.68		

Table 13.

Sample taken from Square J. 19 on 10-5-54.										Sample taken from Square F. 17 on 24-5-54.									
Spring Group					Autumn Group					Spring Group					Autumn Group				
Year-Class	Rings	Number	Mean Vert.S.		Year-Class	Rings	Number	Mean Vert.S.		Year-Class	Rings	Number	Mean Vert.S.		Year-Class	Rings	Number	Mean Vert.S.	
1952	2	2	56.96		1951	2	—	56.37		1952	2	35	56.93		1951	2	35	56.45	
1951	3	30			1950	3	6			1951	3	26			1950	3	41		
1950	4	57			1949	4	16			1950	4	8			1949	4	40		
1949	5	12	57.13		1948	5	5	56.48		1949	5	1	56.63		1948	5	10	56.63	
1948	6	11			1947	6	11			1948	6	1			1947	6	14		
1947	7	9			1946	7	9			1947	7	—			1946	7	11		
1946	8	5	56.72		1945	8	2	56.38		1946	8	—	56.36		1945	8	—	56.36	
1945	9	6			1944	9	10			1945	9	—			1944	9	4		
1944	10	2			1943	10	13			1944	10	—			1943	10	1		
1943 and older > 10	1	1			1942 and older > 10	30				1943 and older > 10	—				1942 and older > 10	9			
Total	135		56.97		Total	102		56.40		Total	71		56.93		Total	165		56.42	

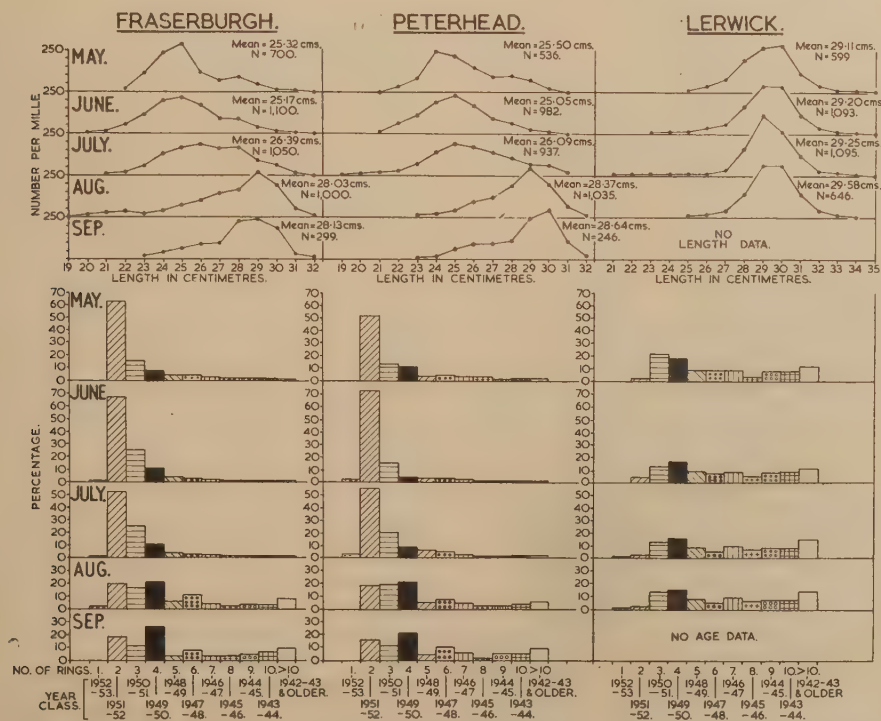
Figure 12. Length and age compositions of north-east coast and Shetland drift-net samples, May—September 1954.
(Length frequencies unsmoothed).

Table 14. Maturity and Racial Characters—North-East Coast and Shetlands.

A. Percentage Maturity (all Age-Groups)														
Maturity Stages	Fraserburgh					Peterhead					Lerwick			
	M.	J.	Jy.	Aug.	S.	M.	J.	Jy.	Aug.	S.	M.	J.	Jy.	Aug.
I.....	52.7	53.0	15.9	3.0	0.3	47.6	54.4	21.9	0.8	—	6.3	6.6	5.1	2.5
II.....	19.4	28.4	26.7	6.3	—	14.2	25.4	29.1	1.7	1.2	24.7	39.9	28.4	19.2
III.....	0.3	4.4	17.9	6.4	1.7	—	3.8	14.9	6.1	6.9	0.7	11.4	28.4	11.9
IV.....	0.1	1.0	17.4	9.4	3.0	—	0.9	12.1	14.5	6.1	0.2	2.5	14.2	10.8
V.....	—	0.3	16.5	17.5	7.0	—	0.2	14.2	28.4	8.4	—	0.3	5.5	23.4
VI.....	0.4	0.2	3.0	33.0	8.7	0.2	—	4.6	33.4	8.1	1.0	—	0.9	12.5
VII and VII—II	27.0	12.8	2.7	24.4	79.3	38.1	15.4	3.2	15.1	69.1	67.1	39.3	17.5	19.7
No. of Fish	700	1,100	1,050	1,000	299	536	982	937	1,035	246	599	1,093	1,094	646

B. Vert. S. (Actual Numbers—and Age-Groups)														
No. of Vertebrae	M.	J.	Jy.	Aug.	S.	M.	J.	Jy.	Aug.	S.	M.	J.	Jy.	Aug.
53	—	1	—	—	—	—	—	—	—	—	—	—	—	—
54	1	—	1	2	—	—	—	2	—	1	—	—	2	—
55	23	24	43	35	10	16	23	20	41	5	14	28	29	25
56	267	419	471	476	146	203	345	385	491	110	208	452	423	260
57	348	568	477	424	127	272	507	450	450	114	307	514	524	296
58	32	61	40	47	11	30	83	53	38	12	57	86	90	51
59	—	3	—	1	—	1	1	1	1	1	4	1	5	—
60	—	—	—	—	—	—	—	—	—	—	—	—	1	—
Mean....	56.58	56.63	56.50	56.49	56.47	56.61	56.68	56.59	56.48	56.55	56.62	56.61	56.64	56.59
No. of Fish	671	1,076	1,032	985	294	522	959	911	1,021	243	590	1,081	1,074	632

M. = May J. = June Jy. = July Aug. = August S. = September.

north-east coast ports, Fraserburgh and Peterhead, and at the Shetland port, Lerwick. Samples were selected so that the whole of the area fished each month at each port was covered. The length and age compositions of the monthly samples for each port are presented in Figure 12, and the maturity and Vert. S. data are given in Table 14.

North-east coast. The stock fished in the months May to July from the north-east coast ports was, like those in the two previous years (Ann. Biol., 9 and 10), composed principally of young herring. Age-groups II—IV constituted over 80% of the fish samples at both ports, and of these the two-year-olds (2 winter-rings) were once again the dominant group. In June, this age-group made up almost 70% of the total, and accounted for over 50% of the samples in May and July. In August a large part of the population of the younger age-groups, particularly of the two-year-old age-group, moved away from the area leaving a smaller stock of adult spawners which were fished on the spawning grounds throughout August and early September.

The stock was again composed almost entirely of autumn spawners, but, as in previous years (Ann. Biol., 9 and 10), the two-year-

old recruit brood contained a proportion of spring-spawned herring. This component constituted approximately 21% of the two-year-olds samples in May and June, but only 2% in July and August. This is in keeping with earlier results and indicates that these fish leave the local grounds at the onset of the autumn-spawning season, and fail to reappear again in the following year.

Shetland. As in previous years the stock fished in the Shetland area contained relatively fewer of the younger broods and more of the older broods than that fished off the Scottish north-east coast. The abundant two-year-old brood appeared on the Shetland grounds in very small numbers, which is an expression of the remoteness of these grounds from any major nursery centre. Members of the three- and four-year-old autumn-spawning broods were recruited to the area, but they were less prominent than was expected in the light of their prominence in the north-east coast stock in the previous two years.

As in 1953, the stock at Shetland contained a higher proportion of spring spawners than was present on the north-east coast grounds. In the peak fishing period in May, spring spawners constituted approximately 30% of

FLADEN.

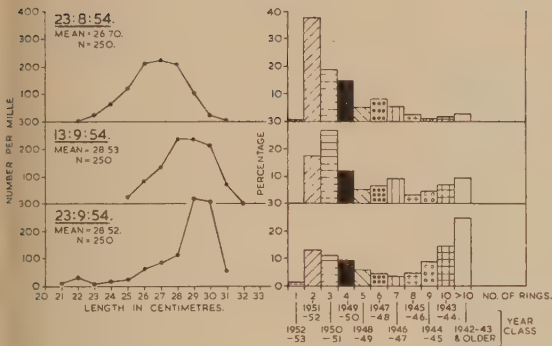


Figure 13. Length and age compositions of Fladen trawl samples, August–September 1954. (Length frequencies unsmoothed).

the fish sampled. These were mostly the younger age-groups III–V, and otolith analysis showed that many of them were herring of Norwegian origin. This spring component of the stock was less prominent in the samples later in the season.

Fladen and Gut. The length and age compositions of the samples taken from vessels fishing at Fladen and on the "Gut" grounds in the period August–October are presented in Figures 13 and 14, and the maturity and Vert. S. data are given in Table 15.

The Fladen stock in 1954 showed the same general changes in composition as in 1953. In August, the younger age-groups, which were encountered in abundance on the Scottish north-east coast grounds earlier in the summer, predominated, but in September, following the spawning season on the adjacent coastal banks, older spent fish made up the greater part of the stock. The two-year-old brood (2 rings) was composed of mixed spring and autumn

"GUT."

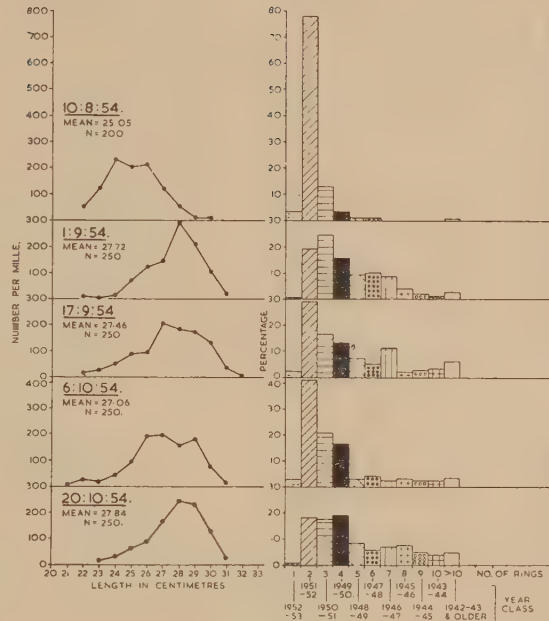


Figure 14. Length and age compositions of "Gut" trawl samples, August–October 1954. (Length frequencies unsmoothed).

spawners in about the same proportion as appeared in the May and June samples on the north-east coast grounds. The "Gut" stock possessed the same general characteristics as that fished off the north-east coast in May–July, i.e., dominance of two-, three- and four-year-old herring. The August sample was made up largely of two-year-olds which were composed almost entirely of the autumn-spawning component. In the other samples this young brood contained members of both components in varying proportions. Fair numbers of one-year-olds (1 ring), mostly of autumn origin, appeared in these samples.

Table 15. Maturity and Racial Characters—Fladen and Gut.

Date of capture	Position in miles from Aberdeen	Statist. Square	A. Percentage Maturity (all Age-Groups).										B. Vert. S. (actual Numbers—all Age-Groups).						
			Maturity Stage																
			I	II	III	IV	V	VI	VII-II	No.									
1954	Fladen												54	55	56	57	58	59	Mean
23/8	100 ENE.	E. 15	15.2	20.4	13.2	12.0	8.8	12.4	18.0	250	—	—	103	136	10	1	56.64		
13/9	100 NE. × E. ½ E.	E. 15	14.4	9.2	10.4	7.6	12.4	7.6	38.4	250	—	4	99	127	16	1	56.64		
23/9	100 ENE.	E. 15	8.0	3.6	2.4	4.4	3.2	0.8	77.6	250	—	6	118	112	9	1	56.52		
	Gut																		
10/8	65 SE. × S. ½ S.	D. 11	10.5	24.0	38.0	19.5	5.0	2.5	0.5	200	2	9	87	93	5	1	56.47		
1/9	125 ESE.	F. 12	6.2	10.4	20.0	14.4	14.8	6.4	28.8	250	—	6	101	128	13	—	56.60		
17/9	135 SE. ½ E.	F. 11	7.2	6.0	21.2	17.6	18.4	11.2	18.4	250	—	10	101	119	18	1	56.59		
6/10	125 SE. × E.	F. 11	17.2	6.8	11.2	10.8	6.0	0.8	47.2	250	—	11	95	121	19	1	56.61		
20/10	157 SE. × E.	G. 11	2.8	4.0	5.6	22.0	11.6	0.4	53.6	250	—	5	96	128	14	1	56.63		



As in previous years, the stocks maintaining the fisheries were of mixed spring and autumn origin. The age data indicate that three and four-year-old fish (3 and 4 rings) predominated during the early part of the year. An abundant brood (1951-52) of new recruits appeared in

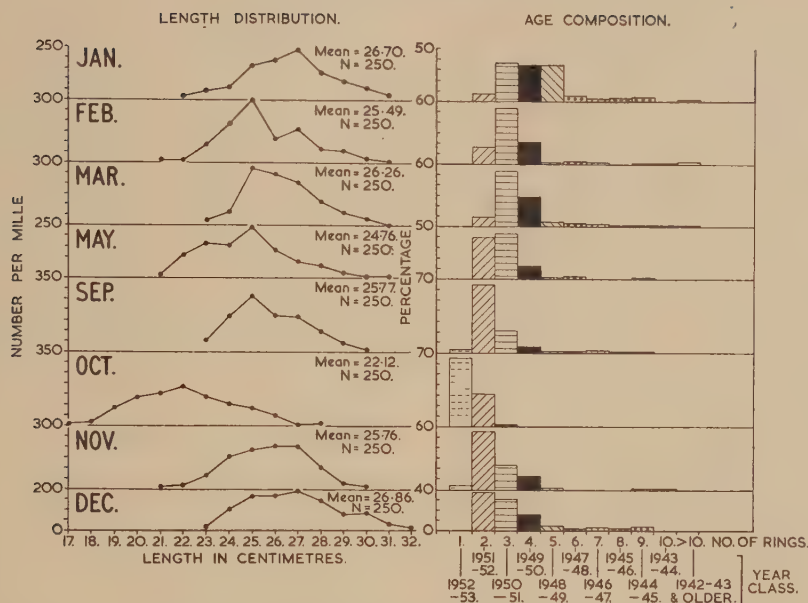
SOUTH MINCH.

Figure 16. Length and age compositions of South Minch drift-net and ring-net samples. January—May and September—December 1954. (Length frequencies unsmoothed).

Table 17. Maturity and Racial Characters—North Minch.

A. Percentage Maturity (all Age-Groups).											
Maturity Stage	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov. Dec.
I.....	13.39	11.42	11.93	5.20	16.52	45.63	36.52	23.10	21.89	26.72	11.50 6.55
II.....	13.18	3.66	22.24	17.60	16.52	43.95	43.70	14.52	17.27	20.04	11.68 6.73
III.....	2.84	11.13	0.72	0.80	3.74	3.11	8.70	10.24	5.42	2.42	5.84 11.27
IV.....	2.84	11.13	0.54	—	0.44	0.24	3.91	22.62	3.41	0.20	1.83 4.55
V.....	3.65	11.86	—	—	—	0.36	6.30	24.52	1.41	0.40	0.36 0.36
VI.....	0.20	33.82	9.95	0.40	2.64	—	—	3.81	—	—	— —
VII & VII-II.....	63.89	16.98	54.61	76.00	60.13	6.71	0.87	1.19	50.60	50.20	68.80 70.55
No.....	493	683	553	250	454	835	460	420	498	494	548 550
B. Mean Vert. S. for each Maturity Stage (all Age-Groups)											
(Nos. in brackets are No. of fish)											
I.....	56.72 (64)	56.60 (79)	56.61 (66)	56.77 (13)	56.79 (72)	56.91 (378)	57.01 (167)	56.86 (94)	56.82 (102)	56.57 (127)	56.68 (66) 56.66 (35)
II.....	56.64 (64)	56.83 (24)	56.52 (121)	56.68 (44)	56.73 (73)	56.57 (363)	56.59 (199)	56.95 (62)	56.91 (85)	56.90 (93)	56.84 (61) 56.91 (34)
III.....	57.29 (14)	57.22 (77)	56.75 (4)	57.00 (2)	56.88 (17)	56.35 (26)	56.50 (40)	56.60 (43)	56.81 (26)	57.00 (11)	57.00 (29) 57.15 (62)
IV.....	56.79 (14)	56.99 (76)	57.00 (3)	—	57.00 (2)	56.55 (2)	56.17 (18)	56.54 (92)	56.50 (16)	57.00 (1)	56.00 (10) 57.00 (25)
V.....	57.00 (18)	57.01 (80)	—	—	—	56.33 (3)	56.55 (29)	56.36 (99)	56.50 (8)	57.00 (1)	57.00 (1) 57.50 (2)
VI.....	56.00 (1)	57.03 (231)	57.11 (54)	57.00 (1)	56.82 (11)	—	—	56.31 (16)	—	—	56.00 (1) —
VII & VII-II.....	56.52 (311)	56.50 (116)	56.59 (297)	56.49 (189)	56.78 (268)	56.77 (56)	57.00 (3)	56.40 (5)	56.56 (240)	56.54 (242)	56.49 (373) 56.47 (380)
Overall mean.....	56.61	56.90	56.63	56.54	56.78	56.73	56.72	56.63	56.69	56.63	56.58 56.62

Table 18. Maturity and Racial Characters—South Minch.

A. Percentage Maturity (all Age-Groups).								
Maturity Stage	JN	F	M	MY	S	O	N	D
I.....	15.60	32.80	16.80	53.20	22.00	76.80	12.80	13.60
II.....	12.40	9.60	22.00	2.80	12.40	5.20	8.40	2.40
III.....	1.20	0.40	—	—	7.20	1.60	1.20	4.80
IV.....	2.80	0.80	0.40	—	4.00	—	1.60	2.80
V.....	0.80	0.40	—	—	1.60	—	0.40	0.40
VI.....	—	—	0.80	—	—	—	—	—
VII & VII-II	67.20	56.00	60.00	44.00	52.80	16.40	75.60	76.00
No.....	250	250	250	250	250	250	250	250

B. Mean Vert. S. for each Maturity Stage (all Age-Groups).								
(Nos. in brackets are No. of fish).								
Maturity Stage	JN	F	M	MY	S	O	N	D
I.....	56.76	56.59	56.55	56.50	56.76	56.55	56.50	56.62
	(38)	(81)	(42)	(172)	(54)	(190)	(82)	(34)
II.....	56.76	56.62	56.61	55.86	57.03	57.00	56.67	56.83
	(32)	(24)	(54)	(7)	(30)	(13)	(21)	(6)
III.....	57.00	57.00	—	—	56.41	56.25	56.67	57.25
	(3)	(1)	—	—	(17)	(4)	(3)	(12)
IV.....	56.86	56.50	56.00	—	56.20	—	57.33	57.00
	(7)	(2)	(1)	—	(10)	—	(3)	(7)
V.....	56.67	57.00	—	—	57.25	—	56.00	57.00
	(3)	(1)	—	—	(4)	—	(1)	(1)
VI.....	—	—	57.33	—	—	—	—	—
	—	—	(3)	—	—	—	—	—
VII & VII-II	56.46	56.58	56.54	56.49	56.46	56.25	56.38	56.42
	(167)	(138)	(147)	(109)	(126)	(40)	(138)	(189)
Overall Mean	56.57	56.59	56.57	56.48	56.60	56.52	56.46	56.51

the catches in the early summer and became the dominant group for the rest of the year.

Vertebral and otolith data revealed that these new recruits were a mixture of spring- and autumn-spawned herring and the spring component was in greater abundance than it had been in the three preceding years.

Clyde. The herring fisheries in the Clyde were again poor in 1954. Samples of adolescent herring taken in the upper reaches of the Firth during the year showed that the stock contained an unusually high proportion of autumn-spawned herring, probably of "Manx" origin.

C. Tagging.

Tagging in 1954 was again conducted from commercial fishing vessels operating in the Scottish fisheries. Liberations were made with the Scottish toggle tag, the Lea tag with a toggle attachment, and the Scottish and Lea tags with a one-man bridle.

The centres of liberation and the numbers liberated were as follows:—

Area	Period of Experiment	Number of Liberations by Type
Upper Moray Firth ("Halflin" stock)	March and December	313 { 280 Lea 33 Scottish
Scottish north-east coast	June and August	1887 { 270 Lea 1617 Scottish
Shetland	May and June	1505 { 571 Lea 934 Scottish
Fladen-Gut	September	231 { 121 Lea 110 Scottish
North Minch	November and December	319 { 20 Lea 299 Scottish
Clyde (Ballantrae Bank)	February	1149 Scottish
Total = 5404		{ 1262 Lea 4142 Scottish

Recaptures up to 15. March, 1955, totalled 79, 21 of which were Lea tags and 58 Scottish. Details of the recaptures from these liberations are summarized below (in brackets days free):—

Upper Moray Firth Liberations.

Area of recapture	Lea	Scottish
Upper Moray Firth.....	5 (0—67)	3 (5—19)
Scottish NE. coast.....	1 (132)	—
Total.....	6	3
% of lib.....	2.1	9.1

North-East Coast Liberations.

Area of recapture		
Scottish NE. coast.....	1 (0)	7 (0—5)
Fladen.....	—	3 (5—45)
Gut.....	—	1 (53)
Dogger.....	1 (?)	—
North Minch.....	—	1 (96)
Unknown.....	1 (?)	—
Total.....	3	12
% of lib.....	1.1	0.7

Shetland Liberations.

Area of recapture		
Scottish NE. coast.....	—	1 (35)
Fladen.....	9 (32—67)	12 (34—96)
Gut.....	1 (56)	2 (66—71)
Dogger.....	—	1 (67)
Skagerak.....	—	2 (235—249)
Unknown.....	1	—
Total.....	11	18
% of lib.....	1.9	1.9

Fladen—Gut Liberations.

Area of recapture		
Dogger.....	1 (9)	—
% of lib.....	0.9	—

North Minch Liberations.

Area of recapture		
North Minch.....	—	1 (39)
% of lib.....	—	0.4

Clyde Liberations.

Area of recapture		
Clyde.....	—	24 ¹ (0—147)
% of lib.....	—	2.1

¹) All but one of these recaptures were made during the course of fishery on Ballantrae Bank.

The most striking features of these results were:—

(1) The absence of substantial numbers of recaptures at Fladen from liberations made on the north-east coast grounds. This is probably due at least in part to the fact that tagging was carried out mainly in August on fish in stages IV—VI, which probably suffer a higher rate of tagging mortality than those of lower maturity stage, tagged earlier in the summer. August liberations in earlier years have also failed to provide satisfactory returns.

(2) The recapture on the North Minch grounds of a herring tagged on the north-east coast grounds. This is the first tag record of a herring moving from the North Sea to the Scottish west coast area, although a recapture on the Fladen in 1954 from a 1953 liberation in the North Minch had provided prior evidence of the reverse movement.

(3) The recapture on the north-east coast grounds of a herring tagged as a "halfin" in the upper Moray Firth the previous winter. This lends some support to other evidence that the upper Moray Firth stock constitutes one of the major sources of recruits to the north-east coast stocks.

Further returns from 1952-53 liberations.

Three recaptures from herring liberated in 1952 and 1953 which were received too late in

1954 to record in the report for 1953 are of interest. They were as follows:—

(1) Liberated on 7. August 1953, 15 miles SE. × S. from the Butt of Lewis (Hebrides)—recaptured on the Fladen on 9. August 1954.

(2) Liberated on 12. June 1952, 62 miles east from Fraserburgh—recaptured on 7. December 1954 on the Sandettié grounds in the English Channel.

(3) Liberated on 21. February 1952, 8 miles SSW. from Tiumpán Head (Isle of Lewis)—recaptured on the Scottish mainland grounds in the North Minch in February 1954.

B. B. PARRISH,
I. G. BAXTER,

G. MCPHERSON,
J. D. BUCHAN.

German Herring Investigations 1946—1949.

Routine work in collecting samples from commercial hauls was done during 1946—1949 by the "Institut für Seefischerei". About 6500 herrings caught by German trawlers on Fladen, Gut and Dogger were investigated at the fish market of Hamburg-Altona. During 1949 examinations were carried out also at sea, 2300 herrings were sampled on board luggers and 800 herrings on board trawlers. In Table 19A the data of length of full (or just spent) and unripe herring are presented. The spawning herring were accompanied by a varying number of immature fish. On the Dogger

Table 19 A. Average Length and Number of Vertebrae.

Dogger	Full				Immature				Adult unripe			
	cm.	No.	V. S.	No.	cm.	No.	V. S.	No.	cm.	No.	V. S.	No.
1946 Sept.—Nov.	26.74	(634)	—	—	24.38	(117) ¹⁾	—	—	—	—	—	—
1947 Sept.—Oct.	26.28	(928)	56.48	(345)	22.80	(151)	56.42	(74)	—	—	—	—
1948 Sept.—Nov.	26.26	(644)	56.48	(279)	22.12	(112)	56.59	(64)	—	—	—	—
1949 Aug.—Oct. a)	26.23	(333)	—	—	22.37	(72)	—	—	—	—	—	—
b)	25.93	(404)	56.50	(392)	21.15	(189)	56.46	(243)	—	—	—	—
Aug.—Nov. c)	26.49	(937)	56.40	(343)	23.81	(64)	56.57	(35)	—	—	—	—
Gut												
1946 Sept.	26.97	(372)	—	—	—	—	—	—	25.68	(27)	—	—
1949 Aug.—Oct. a)	27.29	(210)	—	—	21.70	(71)	—	—	—	(11)	—	—
b)	26.68	(110)	56.44	(111)	21.81	(72)	56.47	(93)	—	—	—	—
July—Aug. c)	23.93	(293)	56.43	(131)	23.35	(353)	56.50	(362)	26.4	(41)	56.68	(25)
Fladen												
1946 Aug.	26.95	(176)	—	—	24.27	(13)	—	—	26.19	(111)	—	—
1947 July—Aug.	26.78	(410)	56.47	(127)	24.34	(98)	56.38	(29)	26.57	(129)	56.36	(50)
1948 Aug.—Sept.	26.89	(749)	56.40	(418)	24.06	(129)	56.66	(108)	26.50	(125)	56.73	(113)
1949 Aug.—Sept. a)	—	(17)	—	—	23.11	(81)	—	—	—	—	—	—
b)	26.44	(179)	56.55	(174)	23.56	(64)	56.66	(79)	26.09	(51)	56.47	(25)
May—July c)	27.33	(79)	—	—	24.42	(271)	—	—	27.20	(292)	—	—

a) Samples taken on board trawlers at sea.

b) Samples taken on the fish market (catches of trawlers).

c) Samples taken on board luggers at sea.

¹⁾ Mixture of immature and adult unripe herring.

Table 19 B. Stages of Maturity.

Stage of maturity		4 years and more						Less than 4 years	
		VII	VI	V	IV	III	II	III	II imm.
1946									
Aug.	Fladen	—	1	66	79	77	62	1	11 —
Sept.	Gut	10	74	162	118	30	6	—	— 3
Sept.-Nov.	Dogger	139	143	135	35	—	—	11	99 25
1947									
July-Aug.	Fladen	80	14	38	178	101	116	15	47 44
Sept.-Oct.	Dogger	200	278	290	136	18	45	18	32 100
1948									
Aug.-Sept.	Fladen	110	35	202	326	102	84	44	50 52
Sept.-Nov.	Dogger	146	189	156	80	8	57	18	26 74
1949									
a)									
Aug.-Sept.	Fladen	—	—	—	4	5	7	4	37 39
Aug., Oct.	Gut	10	7	83	99	24	3	13	15 46
Aug.-Oct.	Dogger	71	0	118	124	11	2	21	9 42
b)									
Aug.-Sept.	Fladen	3	10	81	73	45	21	19	37 11
Aug., Oct.	Gut	1	0	64	32	13	7	11	20 53
Aug.-Oct.	Dogger	81	116	169	47	8	2	15	51 109
c)									
May-July	Fladen	—	—	4	57	144	255	7	125 139
July-Aug.	Gut	—	—	64	167	82	20	115	142 101
Aug.-Nov.	Dogger	211	194	324	151	52	—	27	34 3

a) Samples taken on board trawlers at sea.

b) Samples taken on the fish market (catches of trawlers).

c) Samples taken on board luggers at sea.

unripe adult herring were quite rare during the seasons. In the samples taken at the Fladen sometimes a high percentage of adult unripe (maturity stages II—III) herring was found. The origin of these herrings is unknown, but apparently most of them belong neither to the Atlanto-Scandian type nor to the group of the autumn-spawning herring of the Dogger. In conformity to the measurements published by GILIS the average length of the Dogger herring is higher than in pre-war times.

The distribution of the maturity stages is compiled in Table 19 B. The age of each fish was determined by examination of scales. The samples taken at sea show that young herring were abundant at the Fladen during 1949. A comparison with samples taken on the fish market shows considerable differences, possibly caused by a selection of the small fishes before landing.

Neither the length distribution nor the mean number of vertebrae indicate significant differences between the spawning herring of the Fladen and the Gut. The data found by the census of vertebrae of about 3600 herrings caught in both areas and at the Dogger are given in Table 19 A.

G. HEMPEL.

Spawning Herring from Dogger Bank.

During Danish herring investigations in the North Sea with "Dana" shoals of big spawning herring were observed along the northern edge of the Dogger Bank. On 13.—14. September these herring were caught on four stations between latitudes 55°27'N. to 55°43'N. and longitudes 1°56'E. to 3°36'E. The depth on the fishing stations varied from 37—68 m. and the temperature from 7.2°—10.2°C. A total of 1290 herrings was measured and 425 analysed.

The length distributions from the four stations were alike in showing two maxima—one about 25 cm. and one at 30. cm. of length—but differed rather much in regard to the varying strength of these maxima. The smaller fishes included 1- to 3-ringed herrings in all stages of maturity from I—V, while fishes of 27 cm. and above were homogenous—all being with running spawn and roe or in a stage immediately prior to spawning. Their age composition included fishes with 3—13 rings on the scales, the 6- and 9-ringers being slightly dominant.

The meristic characters of both groups (numbers in brackets) were as follows:—

< 27 cm. length

Mat. I	$K_2 = 14.43$ (30)	V. S. = 56.53 (30)
- II-III	- = 14.80 (46)	- = 56.41 (51)
- IV-V	- = 15.03 (40)	- = 56.47 (45)

27—32 cm.

Mat. V-VI	- = 14.65 (209)	- = 56.58 (208)
-----------	-----------------	-----------------

Two weeks later the research cutter "Jens Væver" reported the presence of big spawning herrings in the area between Outer Rough and Middle Rough. These herrings probably belonged to the same stock.

Further investigations possibly combined with tagging experiments will be carried forth in 1955.

K. POPP MADSEN.

The East Anglian Herring Fishery in 1954. Commercial.

The number of vessels working from the two East Anglian ports has decreased steadily since 1949 when there were 473 steam and motor drifters.

In 1954 only 268 vessels were present. The "average landing" (in crans), however, was considerably greater than in the preceding six years. Immediately after the end of the war, the average landing was 61.0 crans, this very high figure being the result of the "pro-

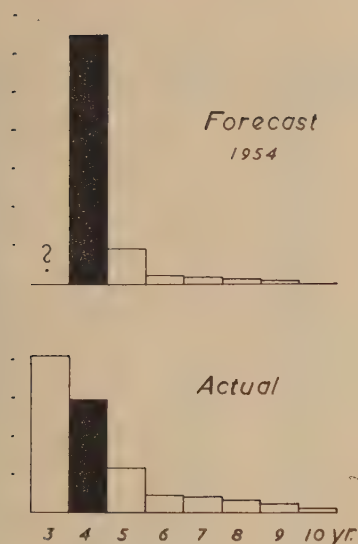


Figure 17.

tection" which the stock enjoyed during the years 1940—45. During the years 1946 to 1953 the average fell to 39.8 crans, but in 1954 it rose to 49.4 crans, the increase being due to the appearance of the very abundant 1951 year-class, i.e., those fish with three growth zones on their scales.

The details of the landings are as follows:—

	No. of landings	Total catch
Lowestoft.....	2157	108,135 crans
Yarmouth.....	2944	144,144 —
Total.....	5101	252,279 —

Average landing: 49.4 crans.

Biological.

It has been customary, for many years past, to issue a forecast of the East Anglian fishery, but in 1951 a change took place in the character of the stock which made it impossible to continue the forecasts. There had been, for many years, a fairly constant relationship between the 3-year-old and 4-year-old fish, consequently it was possible to indicate the

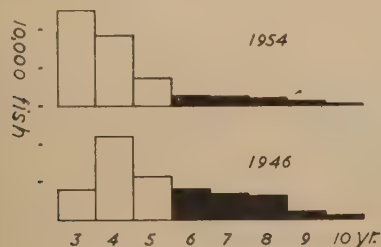


Figure 18.

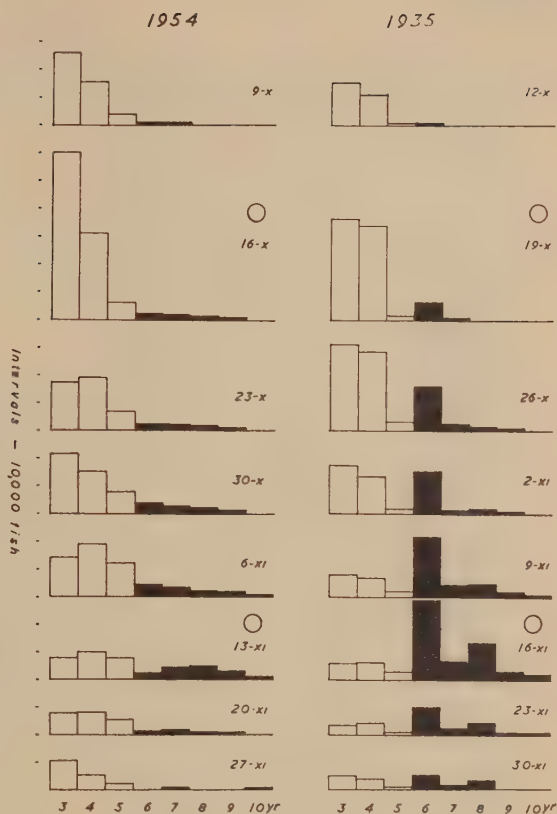


Figure 19.

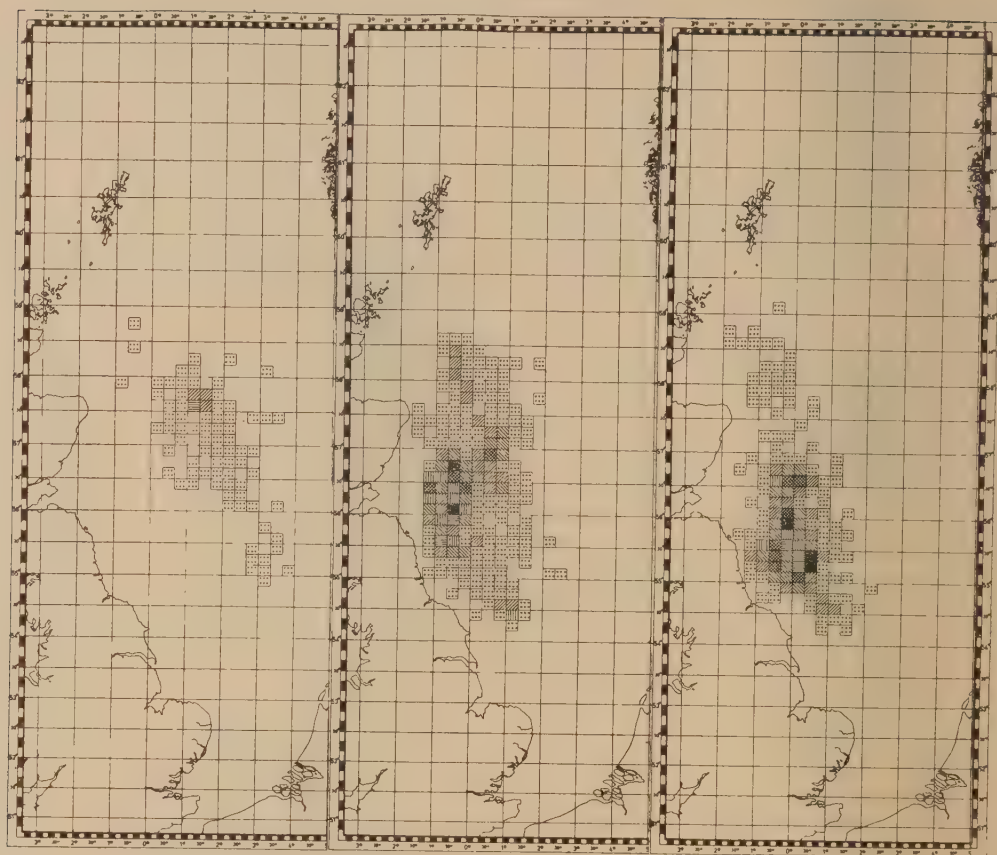
strength of the new four-year-old group with some considerable degree of accuracy. Since this group was usually the most abundant, it was very important from the point of view of the forecast.

Figure 17 shows the error which would have occurred had a forecast been prepared in the usual way. The top half of the figure shows that the fairly rich 1950 year-class, which was present in 1953 as 3-year-old fish, should have produced a large group of four's in 1954, and the proportion between this group and the 1949 year-class (5-year-old) should have been approximately 7:1.

The lower half of the figure shows what actually happened. The 1950 year-class was very much smaller than it should have been and instead of being 7 times greater than the 1949 year-class, the proportion between them was as 2.5:1. The probable cause of this discrepancy is the subject of a report at present in preparation.

A further change which has taken place in

Number of Shots.



Charts 1—3.

May

June

July

the stock, is the gradual decrease in the numbers of older fish, i.e., those aged six years or more, since 1950. The scarcity of old fish in 1954 was very marked and it is clear that the mortality rate of the East Anglian stock is now much greater than it was in 1946.

In Figure 18 is shown the difference between the "average landing" in absolute numbers of fish, in 1946 and 1954.

In 1946 there were approximately 26,200 herrings aged six years or more in the average landing, but in 1954 the number had dropped to 9,700.

This reduction in the numbers of older fish is very important from the commercial point of view, for the following reason: the herrings arrive on the East Anglian grounds in chronological order according to age, the young fish coming first, so the early part of the season—October—is based on 3-, 4- and 5-year-old fish and the later part—November and De-

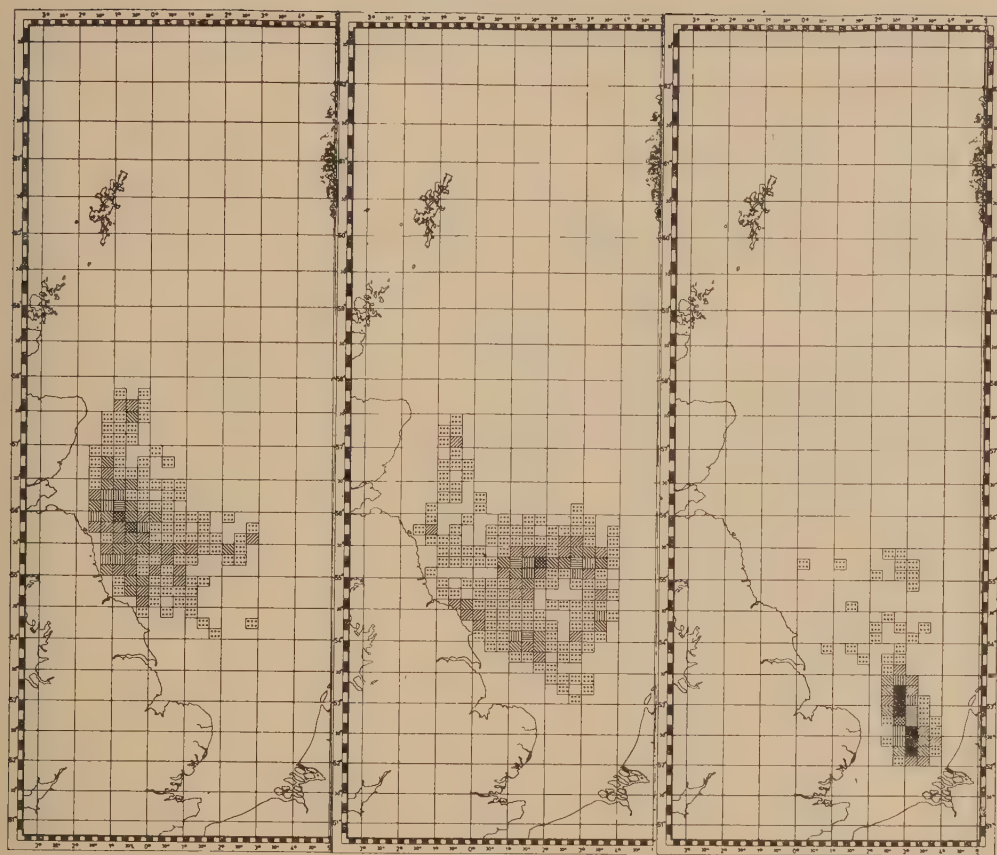
cember—on fish aged six years or more. It follows, therefore, that if the mortality rate is such that the numbers of old fish are greatly reduced there will be a very poor fishing in November and December.

This is what has actually happened in the last two seasons and the outlook for the future is that the fishery will be confined mainly to the month of October with only light landings in November.

Figure 19 shows the comparison between the season of 1954 and that of 1935. The latter season was chosen for comparison because the dates of the full moons were the same as in 1954.

Looking at these two seasons, it is quite clear that the young herrings have behaved in exactly the same way in each of them, that is, they reached their maximum abundance at the time of the October full moon and afterwards they decreased gradually to the end of the season.

Number of Shots.

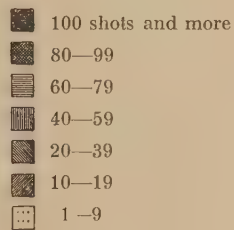
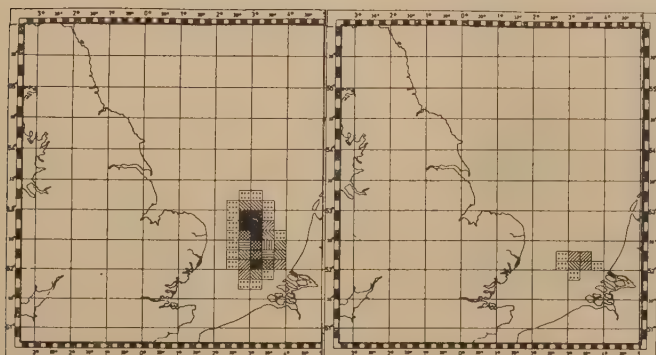


Charts 4—6.

August

September

October

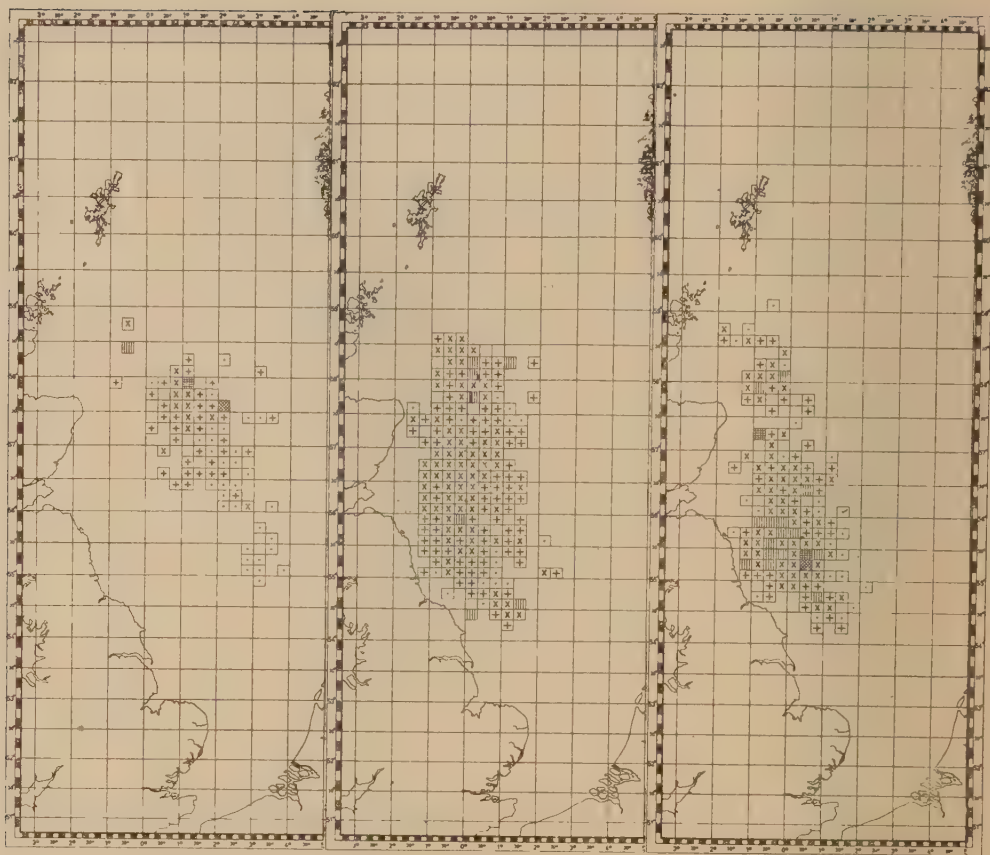


Charts 7—8.

November

December

Mean Catch per Shot (in Kantjes).



Charts 9—11.

May

June

July

The older fish (shown in black) have also behaved in a normal manner in both seasons, that is, they gradually increased in abundance until they reached their maximum at the time of the November full moon. There is, however, a very striking difference in the total quantity of old herrings at the time of the November full moons in the two seasons and the ineffectiveness of the older age-groups in 1954 is clearly seen.

W. C. HODGSON.

The Dutch Herring Fisheries 1954.

Drift-net fisheries.

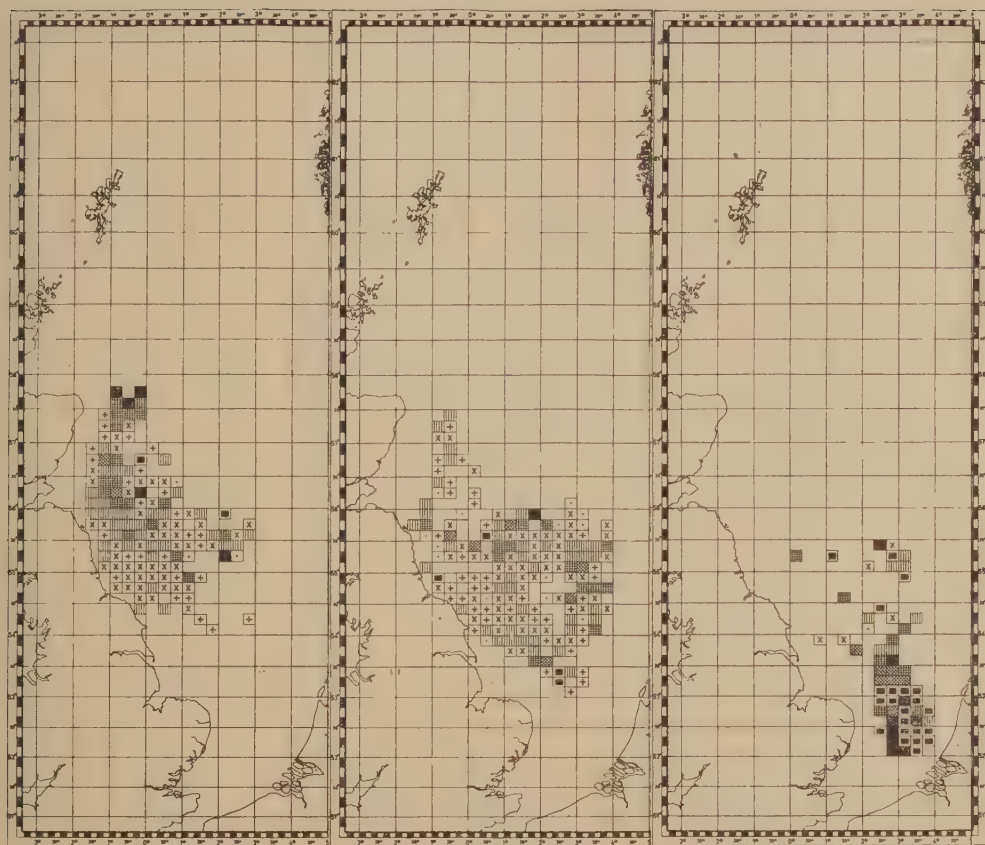
In this year all the vessels gave information about the quantity of the catches and the area where the nets were shot. Charts 1—24 show the results. Fishing started on the 26. May. Until the middle of June the number of nets shot was 50; from 15. June to 12. July the

number rose to 80; thereafter the number of nets shot was about 100 and remained so for the rest of the season. The nets were set either for surface or for deeper water fishing.

The distribution of the fleet this year was about the same as in 1953. The fishery in the Dogger region stopped early; in October almost the whole fishery took place in the East Anglia region. Fishing in this area ended also earlier than normal.

Catches were poor in the beginning of the season, in May, June and July. They were well below the catches in the same period of 1953. August and September gave about the same results as last year. The East Anglian fishery was successful and heavy catches were made. In October catches were higher, in November equal to, and in December lower than in the same months of 1953. The total quantity caught in this fishery exceeded last year's catch.

Mean Catch per Shot (in Kantjes).

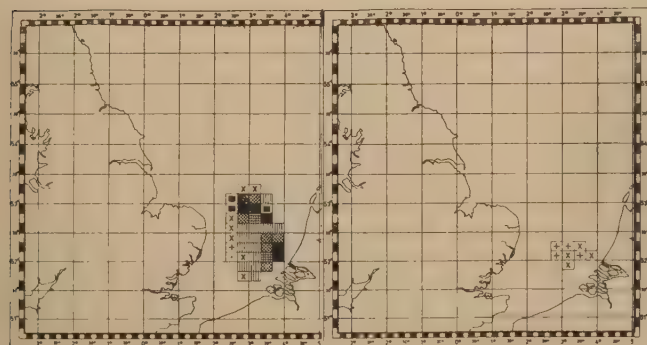


Charts 12—14.

August

September

October

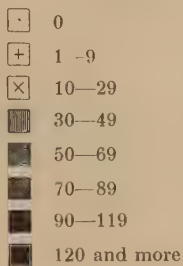


Charts 15—16.

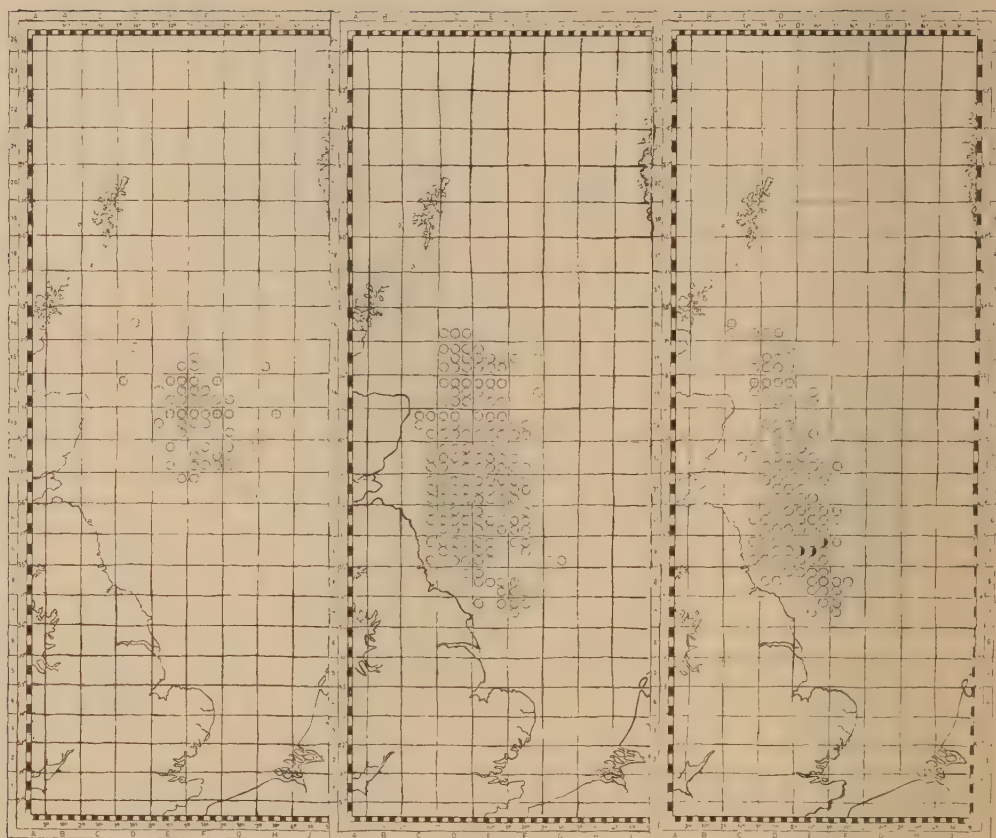
November

December

Mean Number of Kantjes per Shot



Sorting.



Charts 17-19.

May

June

July

The charts of the maturity stages (Charts 17-24) are not different from those of 1953.

Table 20 A gives the total quantity of drift-net herring landed. As in 1953 an amount of ungutted and fresh herring was landed in the period January-May. This is not shown in the charts. The catch of these months was low compared with the previous year.

The total weight of herring landed by drift-net fisheries was 96,999 tons.

J. DE VEEN.

Trawl fisheries.

The catches of herring per 100 hours fishing by the Dutch steam trawlers fishing with the herring trawl are shown in Charts 25-28.

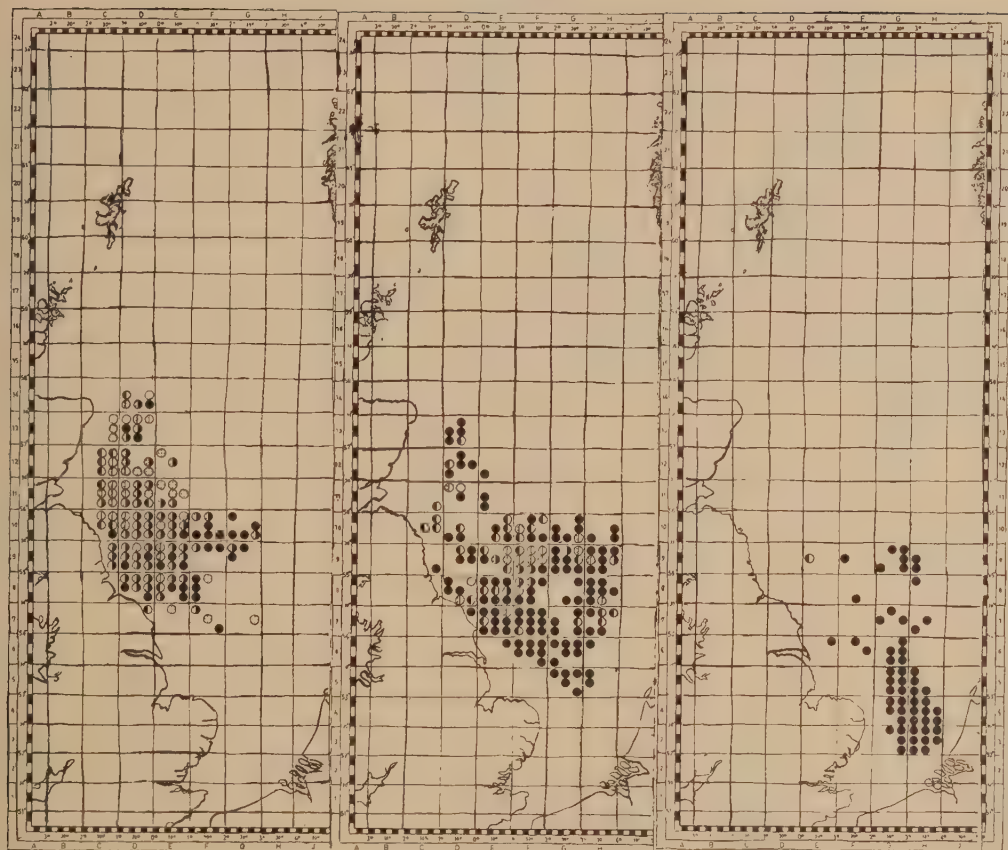
The catches in the Fladen area were about the same as in the previous year. Catches in the Dogger region were well below those of 1953. This might be due partly to bad weather conditions. In general 1954 turned out to be less favourable than 1953.

Table 20 B gives the quantity of herring landed by the trawlers and by the whole fleet fishing with trawl nets. In most months landings were below those of the year before.

The total quantity landed was also considerably lower than in 1953, namely 66,756 tons against 81,849 tons in the previous year.

J. J. ZIJLSTRA.

Sorting.

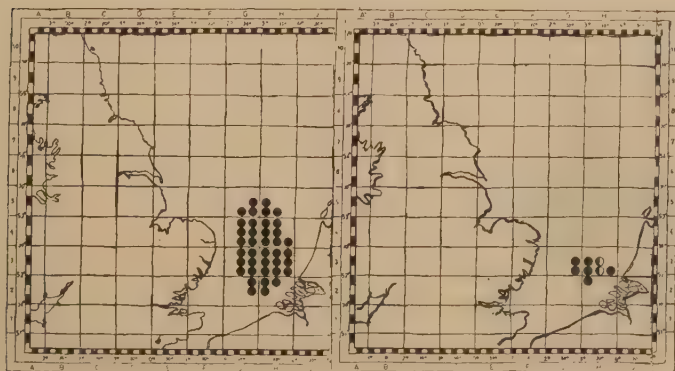


Charts 20—22.

August

September

October



- Matjes
- Matjes and Full
- Matjes, Full and Spent
- Full and Spent
- Full
- Spent

Charts 23—24.

November

December

Dutch Trawl Catches per 100 Hours Fishing.

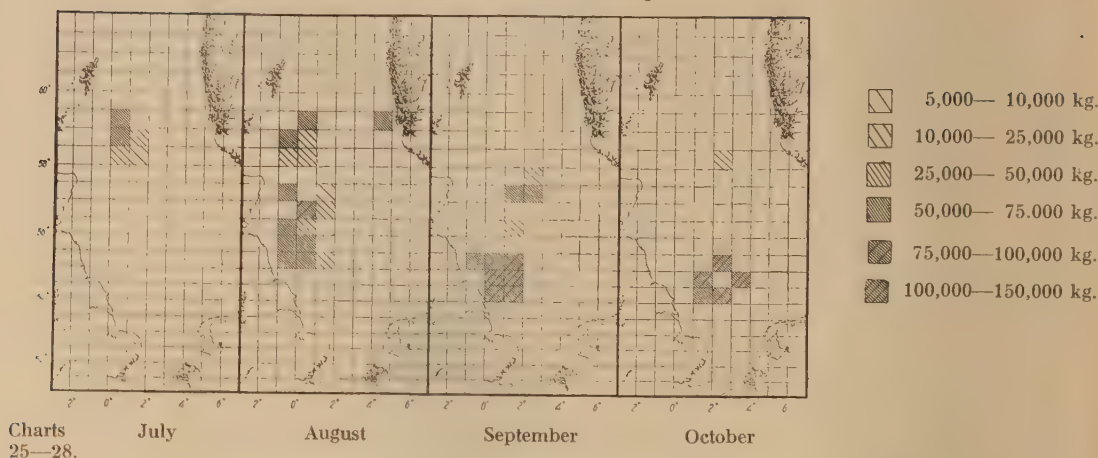


Table 20. Quantities of Herring landed in Dutch Ports in 1954.

Month	A. Landed by Luggers fishing with Drift-Nets				B. Trawled Herring (in tons)	
	Matjes	Salted herring (in kantjes)		Ungutted	Fresh herring (in kg.)	All kinds of vessels
		Gutted	Spent			
January.....	—	—	—	—	254,428	239 777
February.....	—	—	—	—	91,870	127 1,040
March.....	—	—	—	—	249,150	450 1,269
April.....	—	—	—	—	419,120	287 951
May.....	4,920	—	—	45	155,565	348 396
June.....	49,469	—	—	1,507	4,600	45 52
July.....	82,667	5	—	12,308	51,780	1,556 2,745
August.....	51,756	18,440	4,621	11,120	41,240	3,746 11,786
September.....	19,345	31,486	7,293	14,655	7,675	5,260 13,562
October.....	1,091	26,583	1,961	303,040	9,133,445	3,405 7,274
November.....	—	5,474	291	154,930	9,376,508	2,022 3,079
December.....	—	1,431	260	28,773	1,364,648	2,410 3,930
Total 1954.....	209,248	83,419	14,426	526,378	21,150,029	19,895 46,861

Full-Herring Concentrations exploited by the Belgian Herring Trawlers in 1954.

1. Activity—Landings.

As during previous years, the fishery started around mid-July and was carried out on the usual grounds, viz. on the Fladen Ground as well as to the north and east of this area. During August the fishery took place on the Witch Ground and the Old Devil Hole, in September on the Bruceys Garden and on the fishing grounds to the west of the Dogger Bank, in October on the Silver Pit and the Well Bank. During November, the best catches were made around the lightship "Ruytingen", and "Sanddetté", where they consisted mainly of full and ripe herring.

In the northern and central areas of the

North Sea, the fishery was exclusively carried out with the otter-trawl, whereas in the southern area 96.83% of the catches were obtained by the use of the pelagic trawl, towed by two trawlers fishing together. The results gained by each method are given separately.

The total landings of this campaign amounted to 4,679 tons of fish or 4,378 tons herring (93.57%). The otter-trawl gave 2,466 tons herring (56.33%), the pelagic trawl 1,912 tons (43.67%).

2. Fishery.

Tables 21—23 give records of fishing effort and the yield of the fishery, as regards vessels operating with the otter-trawl. Only 12 trawlers participated in the fishery and made 57 trips during the season (Table 21). The catches

Table 21. Number of Trips with Otter-Trawl and Fishing Effort.

Months	Number of trips				Fishing effort (1000 FH x h. p.)			
	North.	Centr.	South.	Total	North.	Centr.	South.	Total
July.....	5	—	—	5	466	—	—	466
August.....	9	2	—	11	744	133	—	877
September.....	1	14	—	15	82	655	—	737
October.....	—	19	—	19	—	615	—	615
November.....	—	—	7	7	—	—	201	201
Total 1954.....	15	35	7	57	1,292	1,403	201	2,896
Total 1953.....	31	86	13	130	2,269	3,875	301	6,445

were mainly composed of herring (Table 22), the yield of which totalled 2,466 tons (Table 23) or 97.17% as against 7,433 tons in the previous season. The catch per trip (43 tons) was 24.56% lower than in the previous season (57 tons). Table 24 shows the number of trips, total catch and yield per trip from the pelagic fishery. It appears that the yield per-unit-of-effort (catch per trip) is only 20.65% of that from the otter-trawlers.

Table 22. The Total Yields by Otter-Trawl Vessels.

	Species	Tons	%
Pelagic	Herring.....	2466	892
—	Sprat.....	0.3	0
—	Mackerel.....	141	51
Demersal	Haddock.....	28	10
—	Cod.....	51	19
—	Saithe.....	15	5
—	Whiting.....	39	14
—	Others.....	26	9
Total Pelagic Species.....		2607.3	943
Total Demersal Species.....		159	57
Grand Total.....		2766	1000

Table 24. Fishing Effort and Yield of the Fishery with Pelagic Trawl.

Months	No. of trips	Total catch (tons)	Ay. catch per trip (tons)
October.....	33	234	7.1
November....	180	1669	9.3
December.....	1	8	7.7
Total 1954....	214	1912	Mean 8.9
Total 1953....	183	2466	Mean 13.4

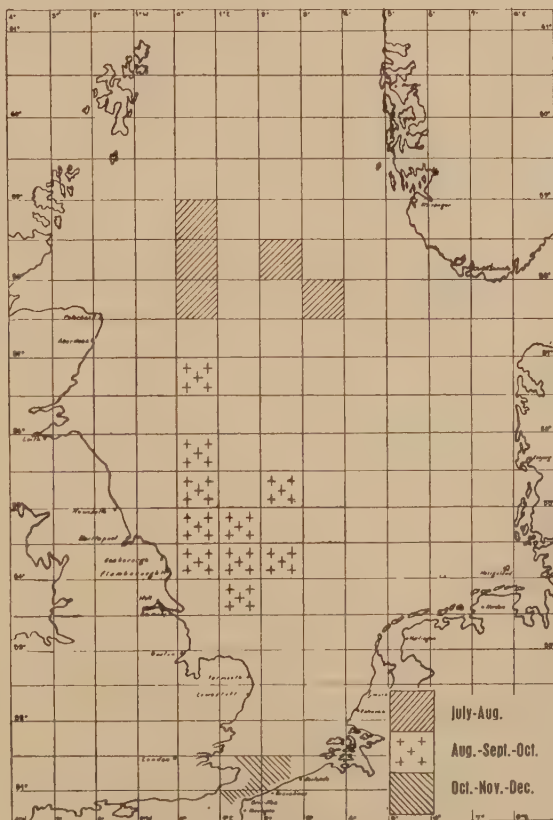


Figure 20. Fishing grounds exploited by Belgian herring trawlers in 1954.

Table 23. The Yields of Herring (Otter-Trawl).

Months	Total catch (tons)				Catch per trip (tons)			
	North.	Centr.	South.	Total	North.	Centr.	South.	Total
July.....	145	—	—	145	29	—	—	29
August.....	550	86	—	636	61	43	—	58
September.....	99	697	—	796	99	50	—	53
October.....	—	698	—	698	—	37	—	37
November.....	—	—	191	191	—	—	27	27
Total 1954.....	794	1481	191	2466	53	42	27	43
Total 1953.....	1638	5244	551	7433	52	61	42	57

Table 25. Size, Weight and Sex (‰).

Cm.	By Areas				By Months			
	North.	Centr.	South.	Total	Aug.	Sept.	Oct.	Nov.
30.....	60	63	12	53	60	60	65	12
29.....	102	132	47	109	102	125	138	47
28.....	108	148	146	136	108	102	194	146
27.....	170	127	106	135	170	155	98	106
26.....	150	153	102	143	150	190	116	102
25.....	162	144	158	152	162	188	100	158
24.....	102	103	228	125	102	110	96	228
23.....	72	79	150	90	72	58	100	150
22.....	38	25	47	32	38	10	40	47
21.....	28	17	4	18	28	2	33	4
20.....	8	7	—	6	8	—	15	—
19.....	—	2	—	1	—	—	5	—
Total...	1000	1000	1000	1000	1000	1000	1000	1000
Average length mm..	265	267	258	265				
Mode cm...	27	26	24	25				
Weightg.	170	162	137	160				
Males ‰	495	504	496	500				

Table 26. Stages of Maturity (‰).

Stages	By Areas				By Months			
	North.	Centr.	South.	Total	Aug.	Sept.	Oct.	Nov.
I.....	45	60	12	48	45	7	113	12
II.....	15	35	12	26	15	22	48	12
III.....	212	25	—	72	212	48	2	—
IV.....	418	99	—	169	418	150	48	—
V.....	305	405	268	353	305	435	374	268
VI.....	—	263	464	225	—	180	347	464
VII.....	—	35	35	26	—	48	23	35
VIII—II	5	78	209	81	5	110	45	209
Total...	1000	1000	1000	1000	1000	1000	1000	1000

Table 27. Quantity of Intestinal Fat (‰).

Quantity	By Areas				By Months			
	North.	Centr.	South.	Total	Aug.	Sept.	Oct.	Nov.
0.....	50	233	358	204	50	208	259	358
1.....	240	490	610	442	240	525	455	610
+.....	348	174	24	196	348	197	150	24
M.....	362	103	8	158	362	70	136	8
Total...	1000	1000	1000	1000	1000	1000	1000	1000

Table 28. Age (‰).

Age	Year-class	By Areas				By Months			
		North.	Centr.	South.	Tot.	Aug.	Sept.	Oct.	Nov.
2	1952	46	14	10	21	46	4	27	10
3	1951	235	140	446	231	235	168	107	446
4	1950	267	261	270	265	267	347	160	270
5	1949	129	166	64	135	129	156	178	64
6	1948	64	88	73	79	64	69	111	73
7	1947	83	68	44	66	83	46	93	44
8	1946	74	96	39	78	74	88	107	39
9	1945	51	39	10	35	51	42	35	10
10	1944	23	27	24	25	23	15	40	24
> 10	< 1944	28	101	20	65	28	65	142	20
Total.....		1000	1000	1000	1000	1000	1000	1000	1000

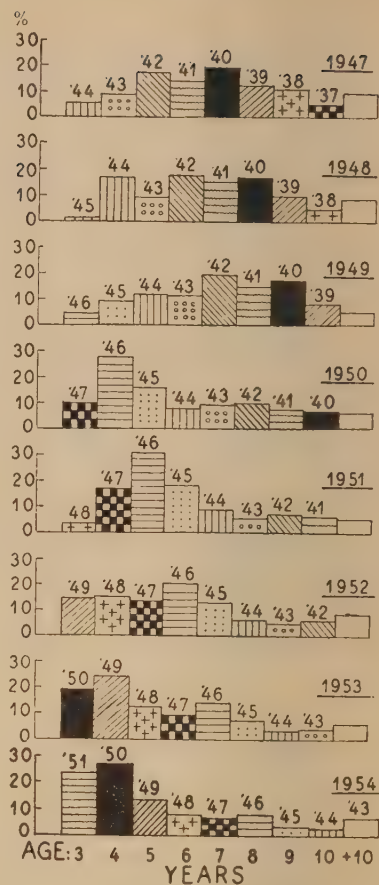


Figure 21. Biological scale of the full-herring concentrations exploited by the Belgian herring trawlers in 1947–1954.

3. The herring stock.

The material investigated consisted of 23 samples comprising 1,452 fish covering the northern (400), central (798) and the southern (254) area. It was collected in August (400), September (400), October (398) and November (254).

Table 25 shows the size distribution of the herring by areas and from month to month during the season. The average weight and the percentage number of males are also recorded. The average size of the fish (265 mm.) was smaller than in 1953 (269 mm.), the average weight was only 160 g. against 175 g. in 1953.

As to maturity it is evident from Table 26 that stage IV was largely predominating in all areas. As in earlier investigations the quantity of intestinal fat was estimated. The results are shown in Table 27.

Table 29. Age Composition of the Catches during 1947-1954 ($\%$ ₀₀).

Age	Years										Average age
	1947	1948	1949	1950	1951	1952	1953	1954			
2	—	—	—	—	—	—	—	4	21	5	
3	54	14	45	99	34	146	196	231	138		
4	95	167	91	278	163	148	243	265	200		
5	171	94	122	158	305	135	127	135	143		
6	148	176	114	78	180	201	91	79	119		
7	190	153	192	89	90	126	139	66	125		
8	108	167	145	96	56	62	69	78	91		
9	114	97	165	73	69	45	35	35	68		
10	38	45	77	66	56	57	39	25	47		
> 10	82	87	49	63	47	80	57	65	64		

Table 30. Average Lengths by Age and the Value of L_1 (mm.).

	Lengths					L_1			
	Brood	North.	Centr.	South.	Mean	North.	Centr.	South.	Mean
1952	216	218	219	217	158	151	149	154	
1951	237	245	241	242	120	123	127	124	
1950	260	262	257	260	108	113	119	113	
1949	277	276	272	275	105	115	107	112	
1948	281	283	284	289	113	114	116	114	
1947	288	287	289	287	111	112	123	113	
1946	292	290	283	290	108	112	109	111	
1945	294	297	288	296	100	121	109	113	
1944	298	300	295	298	128	124	117	123	
< 1944	302	298	294	298	113	116	104	115	
Averages	265	274	257	268	114	116	121	117	

Table 31. Vertebrae (VS $\%$ ₀₀).

VS	By Areas				By Months			
	North.	Centr.	South.	Total	Aug.	Sept.	Oct.	Nov.
59.....	—	1	—	1	—	3	—	—
58.....	51	50	49	50	51	54	44	49
57.....	466	483	476	477	466	495	471	476
56.....	423	405	426	413	423	396	414	426
55.....	56	52	41	51	56	49	55	41
54.....	2	9	8	7	2	3	16	8
53.....	2	—	—	1	2	—	—	—
Total.....	1000	1000	1000	1000	1000	1000	1000	1000
Average.....	56.499	56.516	56.516	56.511	56.499	56.557	56.474	56.516

Table 32. Average Number of Vertebrae according to the Stages of Maturity.

Stages of Maturity	Northern		Central		Southern	
	Number	Vertebral average	Number	Vertebral average	Number	Vertebral average
I.....	18	56.33	45	56.69	3	56.67
II.....	6	56.83	27	56.33	3	56.33
III.....	84	56.57	18	56.50	—	—
IV.....	165	56.58	75	56.51	—	—
V.....	120	56.36	312	56.56	65	56.55
VI.....	—	—	201	56.46	114	56.54
VII.....	—	—	28	56.46	9	56.44
VIII-II.....	2	56.00	62	56.47	50	56.42
Total.....	395	56.50	768	56.52	244	56.52

The composition of the catches, as to age, is demonstrated in Table 28. It appears that the 4-year-old fish was predominant in the northern and central areas whereas in the southern area the 3-year-old fish was largely predominating. The sequence of the most important year-classes, as to their relative strength proved to be as follows: 1950 (265 $\%$ ₀₀), 1951 (231 $\%$ ₀₀), 1949 (135 $\%$ ₀₀) and 1948 (79 $\%$ ₀₀).

It is of great interest to compare the age composition of the catches from year to year as is done in Table 29. The table deals with the 8-year period from 1947 to 1954. It is seen that the absolute dominant is found in one of the age-groups IV—VII. It seems that the 1946-brood has been the most successful one

during the period, being an absolute dominant through 3 subsequent years (1950—1952). It is also interesting to note that during recent years (1950—1954) the fish has tended to be younger than before, taking the stock as a whole. At the same time there has been a general trend towards increased average length of the whole stock (Table 30). On the other hand the growth-rate during the first year (L_1) does not seem to have changed very much (Table 30).

As to the number of vertebrae (VS) a survey is given in Table 31. The average figure for the whole season was found to be 56.511. Up to now the vertebral average of the herring of stages of maturity I to III was always markedly

Table 33. Keeled Scales (K_2) in ‰

K_2	By Areas				By Months			
	North.	Centr.	South.	Total	Aug.	Sept.	Oct.	Nov.
18.....	5	1	—	2	5	—	2	—
17.....	18	23	8	19	18	23	23	—
16.....	168	150	159	157	168	149	151	159
15.....	455	428	490	446	455	443	413	490
14.....	307	344	323	330	307	338	350	323
13.....	40	51	20	42	40	43	59	20
12.....	7	2	—	3	7	2	2	—
11.....	—	1	—	1	—	2	—	—
Total.....	1000	1000	1000	1000	1000	1000	1000	1000
Mean.....	14.809	14.741	14.813	14.773	14.809	14.753	14.729	14.813

higher than the average of the herring of stages IV to VIII—II. This fact served to a certain extent as a basis to distinguish the "spring-" and "autumn-spawners", the simultaneous presence of which was regularly observed in the North Sea above 56° Lat. N. During 1954, the vertebral average of the herrings of stages I to III was 56.544 and this average for the herrings of stages IV to VIII—II 56.505, being a difference of 0.039 vertebrae between the two different maturity groups. Such a small difference does not allow a distinction of the different races or populations present in the material studied.

Finally Table 33 gives the number of keeled scales (K_2) by areas and by months. The average number for the whole season was found to be 14.773.

Stomach analyses were made on all the herring investigated. Only 5.9% were found to contain food, mostly remains of copepods.

4. Forecasts for the full-herring campaign 1955.

The frequency of the year-classes allows us to anticipate for next year rich contingents of the year-classes 1951 and 1950 (4- and 5-year-old herrings) and in a certain measure of the year-class 1949 (6-year-olds). The year-classes before 1949, owing to their age, will in future years give smaller contingents.

Concerning the probable results of the full-herring fishery in 1955, it is difficult to say anything definite at this moment. It will depend chiefly upon the 1952 year-class (3-year-old herrings), which will attain in 1955 its maturity for the first time. Also it may be that the intensity of the exploitation, which the concentrations underwent during these last years, is taxing the richness of the herring stocks too heavily.

CH. GILIS.

Spent-Herring Concentrations exploited by the Belgian Herring Trawlers in 1954-55.

1. Fishing effort.

The first spent-herring catches were landed on 2. December 1954 and the last on 23. February 1955.

During this period, the Belgian fishery was localized in the extreme south of the North Sea and mainly in the relatively small area limited by the lightship "West-Hinder", the eastern English Channel, the lightships "Ruytingen" and "Sandettié".

All spent-herring catches were caught with the pelagic trawl, towed by two trawlers fishing together.

In Table 34 a survey is given of the fishery effort and yields, comparison being made with the previous season. In this season 56 trawlers were engaged in the fishing (89 in 1953-54) and 661 (594) voyages were made.

2. Landings.

The total catch amounted to 7,988 tons consisting of 7,977 tons of herring or 99.86% and 11 tons other sea products, or 0.14%.

In Table 34 details are given as regards the landings from the pelagic trawl. The average yield per trip varied considerably from month to month. It reached its maximum in January with 15.5 tons and the average yield for the

Table 34. Fishing Activity—Total Yields and Yields per-Unit-of-Effort (Pelagic Trawl).

Months	Number		Trips	Total	Catch per	
	Ves.	V. × h.p.			trip	V. × h.p.
	sels	(1000)		(tons)	(tons)	(kg.)
December....	46	75.0	215	2179	10.0	29
January.....	53	104.1	294	4550	15.5	44
February....	46	54.9	152	1248	8.2	23
1954-55.....	56	234.0	661	7977	12.1	34
1953-54.....	89	194.5	594	10173	17.1	52

Table 35. Survey of Fishing Effort and Yields during the Seasons 1941-42 to 1954-55.

Spent-herring season	Number of trips				Weight landed per 1 h.p. × F.D.	
	Number of trawlers	Individual trawlers	Bull-net trawlers	Total (tons)	Individual trawlers (kg.)	Bull-net trawlers (kg.)
1941—42.....	161	2,383	—	10,031	119	—
1942—43.....	290	9,165	—	51,895	164	—
1943—44.....	337	9,379	—	58,120	130	—
1944—45.....	280	3,889	—	31,446	160	—
1945—46.....	345	6,530	—	26,359	68	—
1946—47.....	346	4,639	—	22,172	50	—
1947—48.....	243	2,190	—	6,758	32	—
1948—49.....	258	3,776	—	9,522	26	—
1949—50.....	176	857	436	2,426	15	17
1950—51.....	67	323	18	1,706	32	44
1951—52.....	52	225	177	3,475	26	43
1952—53.....	70	—	561	6,130	—	33
1953—54.....	89	—	594	10,173	—	52
1954—55.....	56	—	661	7,977	—	34

whole season was 12.1 tons as against 17.1 tons during the previous season.

It is also of interest to consider the effort made and the yield of this effort for a series of seasons as is done in Table 35. It appears that the number of fishing vessels participating, the number of trips made, the total yield and the yield per-unit-of-effort have decreased.

3. The herring stock.

During the season 1,156 herrings were investigated, 406 in December, 550 in January and 200 in February.

The size distribution, the average size and the weight of the herring from month to month, can be seen in Table 36. It must be noted that the length (266 mm.) as well as the weight (123 g.) proved to be a little higher than in the previous season (263 mm., 119 g.).

The age composition of the stock is shown in Table 37. The fishing was evidently based on 3—7-year-old herring (year-classes 1947—1951), which contributed altogether by 77.9% of the total catch. The 3-year-old fish (1951) made out nearly a quarter (24.5%) of the total yield.

The average length of each particular year-class is set out in Table 39, where the difference in length between neighbouring year-classes (annual increment) is also given. Furthermore the growth of the first year (L_1), which terminates when the innermost ring in the scale is formed, is shown.

It is of great interest to compare, over a period of seasons, the average length of the herring in relation to age as it is done in

Table 36. Spent-Herring—Length, Weight and Sex.

Cm.	Length ‰				Average	English Channel Jan.	Total
	Southern North Sea						
Dec.	Jan.	Febr.					
30.....	20	3	15	12	23	14	
29.....	71	77	160	91	104	93	
28.....	202	178	295	212	225	214	
27.....	155	148	170	156	220	165	
26.....	118	95	130	112	156	119	
25.....	126	120	55	109	116	110	
24.....	200	199	95	178	98	166	
23.....	96	133	60	103	58	96	
22.....	12	34	10	20	—	17	
21.....	—	13	10	7	—	6	
Total.....	1000	1000	1000	1000	1000	1000	
Average length mm.				265	270	266	
Average weight g.				122	127	123	
Males ‰				468	427	462	

Table 37. Age Distribution (‰). N = 907.

Winter- rings	Age Years	Year- class	Southern North Sea				E. Chan.	
			Dec.	Jan.	Febr.	Average	Jan.	Total
1	2	1952	3	9	—	5	—	4
2	3	1951	250	332	159	261	91	245
3	4	1950	224	214	180	210	216	211
4	5	1949	123	115	164	129	182	134
5	6	1948	84	78	122	90	136	95
6	7	1947	75	74	148	92	114	94
7	8	1946	104	87	127	103	125	105
8	9	1945	78	47	58	61	68	62
9	10	1944	33	16	21	23	34	24
> 9	> 10	< 1944	26	28	21	26	34	26
Total			1000	1000	1000	1000	1000	1000

Table 38. Age Composition of the Catches during 1947-48 to 1954-55 (‰).

Age	Years								
	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54	1954-55	Average
2.....	—	2	—	—	4	12	5	4	4
3.....	115	94	184	174	197	372	276	245	204
4.....	94	116	195	222	266	124	216	211	175
5.....	167	59	75	187	237	153	125	134	133
6.....	88	165	45	84	140	120	119	95	110
7.....	79	98	124	65	65	95	121	94	95
8.....	40	95	88	103	32	46	80	105	76
9.....	180	70	72	60	39	24	25	62	68
10.....	55	132	70	43	4	30	16	24	51
10.....	182	169	147	62	16	24	17	26	85

Table 39. Average Length, annual Increment and first Year's Growth of the various Year-Classes (mm.).

Year-class	Dec.	Average length				E. Chan. Jan.	Total	Growth of the 1st year (L ₁)					
		Southern North Sea			Ann. Incr.			Southern North Sea			E. Chan.		Total
		Jan.	Febr.	Average				Dec.	Jan.	Febr.	Aver.	Jan.	
1952	235	230	—	232	—	—	232	168	161	—	163	—	163
1951	244	240	241	242	10	246	242	124	123	125	124	124	124
1950	260	261	264	261	19	262	261	118	123	119	120	117	120
1949	276	273	278	276	15	273	275	112	109	110	111	110	111
1948	279	280	284	281	5	281	281	112	103	115	110	109	110
1947	287	285	286	286	5	287	286	116	112	116	115	119	115
1946	284	286	287	286	—	285	286	108	107	113	109	110	109
1945	289	289	292	290	4	288	290	108	106	106	107	101	106
1944	285	291	287	287	—	289	287	109	101	109	107	103	106
1944	288	289	291	289	2	294	290	110	106	120	110	99	109
Average	268	263	274	267	—	275	268	116	116	116	116	112	116

Table 40. Survey of Mean Length during the last 8 Seasons (mm.).

Campaigns	Age (Years)							
	3	4	5	6	7	8	9	10
1947-48...	231	248	256	265	270	273	273	275
1948-49...	233	249	255	264	267	273	276	275
1949-50...	223	246	254	265	268	272	277	277
1950-51...	236	245	257	264	269	274	277	278
1951-52...	235	250	260	265	270	276	274	277
1952-53...	239	255	268	271	276	279	281	280
1953-54...	240	260	270	278	280	283	286	287
1954-55...	242	261	275	281	286	286	290	287
Gen. Aver...	235	252	262	269	273	277	279	280

Table 42. Stages of Maturity (‰).

Stages	Southern North Sea				E. Channel General	
	Dec.	Jan.	Febr.	Average	Jan.	Average
I.....	12	8	5	9	—	8
II.....	7	8	—	6	—	5
III.....	—	—	—	—	—	—
IV.....	—	—	—	—	—	—
V.....	15	3	—	7	—	6
VI.....	10	5	—	6	6	6
VII.....	64	5	10	31	17	29
VIII-II..	892	971	985	941	977	946
Total....	1000	1000	1000	1000	1000	1000

Table 41. Total Number of Vertebrae (VS ‰).

VS	Southern North Sea				E. Channel General	
	Dec.	Jan.	Febr.	Average	Jan.	Average
60.....	2	—	—	1	—	1
59.....	—	—	—	—	—	—
58.....	49	36	77	50	72	53
57.....	497	523	495	507	527	510
56.....	429	413	412	419	377	413
55.....	23	28	16	23	24	23
Total....	1000	1000	1000	1000	1000	1000
Average..	56.582	56.568	56.634	56.587	56.647	56.596

Table 43. Quantity of Intestinal Fat (‰).

Quantity	Southern North Sea				E. Channel General	
	Dec.	Jan.	Febr.	Average	Jan.	Average
0.....	291	167	80	200	231	205
1.....	677	801	745	739	763	742
+.....	17	21	175	51	6	44
M.....	15	11	—	10	—	9
Total....	1000	1000	1000	1000	1000	1000

Table 44. Keeled Scales (K_2) in ‰

K_2	Southern North Sea				E. Channel General	
	Dec.	Jan.	Febr.	Average	Jan.	Average
18.....	2	5	5	4	—	4
17.....	17	24	10	19	17	18
16.....	177	200	115	173	127	166
15.....	473	473	470	472	439	467
14.....	294	258	350	291	353	301
13.....	37	37	50	40	64	43
12.....	—	3	—	1	—	1
Total....	1000	1000	1000	1000	1000	1000
Average..	14.851	14.923	14.700	14.848	14.682	14.823

Table 40. It is quite striking that an increase in length has taken place all over.

The number of vertebrae was a little higher than last year being 56.60 (against 56.56) as shown in Table 41. Frequency distribution in different months is also shown in this table.

Tables 42 and 43 illustrate the number of herrings in the different stages of maturity from month to month (Table 42) and the relative quantity of intestinal fat, also by months. As usual the greatest part of the stock is just spent or recovering spents, and the small amount of fat is in good agreement with that fact.

Finally Table 44 gives the number of keeled scales (K_2). The average number for the whole period was found to be 14.823.

4. Forecasts for the campaign 1955—56.

Once again the youngest year-classes provide the largest contingents. They totalize 69% of the total number of herrings examined.

Based upon the frequency of the year-classes, it may be presumed that the 1955—56 concentrations will largely consist of herrings belonging to the year-classes 1951, 1950 and 1949 (4, 5 and 6-year-old herrings) as well as to the 1946 year-class (9-year-old), which

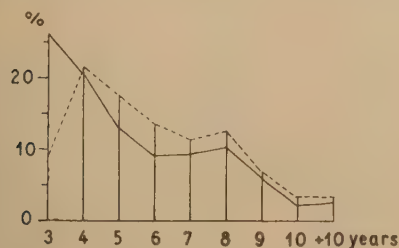


Figure 22. Biological scale of the spent-herring concentrations 1954—1955.
— Southern North Sea.
----- Eastern English Channel.

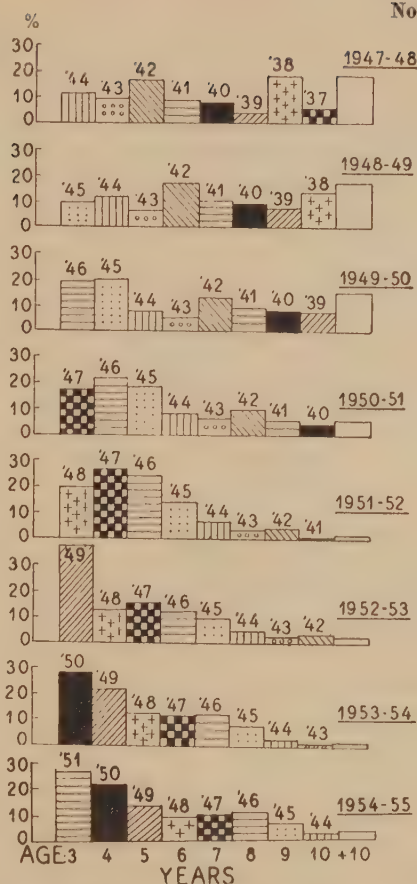


Figure 23. Biological scale of the spent-herring concentrations during the period 1947—48—1954—55.

notwithstanding its age has still given a large contingent.

The prospects for the fishery are less good than the previous year. Indeed, the average catch per V. × h.p. has decreased very markedly. If the year-class 1952, which next winter will attain its maturity for the first time, happens to be rather poor, it is probable that the catches in relation to the fishing effort will again be on the decline.

During January 1955 we have examined some samples taken from catches obtained in the eastern English Channel (off Boulogne). Apart from the average length of the herrings and the vertebral average, which are rather higher, the biological values do not differ much from those observed in the samples having the southern North Sea for origin.

CH. GILIS.

C. The Skagerak, Kattegat, Belt Sea and Baltic.

YOUNG STAGES

Larvae in the Kattegat, Sound and Belt Sea.

Some few hauls with the 2 m. ring-net from the S/S "Biologen" in March in the SW. Kattegat and the Belts gave only one larvae of autumn-spawning herring which confirms that the autumn of 1953 has given only a few larvae in this region (cp. Ann. Biol., 10, p. 187). By hauls during May in the Kattegat, the Sound and the Belt Sea only rather few larvae of winter and spring spawning herring were caught.

COMMERCIAL FISH

Small Immature Herring.

Skagerak and northern Kattegat.

In February the samples of 0-group herring were mixtures of the western North Sea autumn spawners and coastal autumn spawners (the first sample of Table 45) or mixtures of spring

spawners of the Atlanto-Scandian type and coastal spring spawners (second sample). In March the largest of the 0-ringed were of the Atlanto-Scandian type but the smallest were North Sea autumn spawners. During May—December all of the 0-ringed were North Sea autumn spawners with V.S. ca. 56.5 and K₂ ca. 14.7.

The 1-ringed in February were pure Atlanto-Scandian spring spawners, and these dominated in two of the samples from July—August, while one sample were of the northern Kattegat deep-sea autumn spawners, the Kobbergrund herring, and in five samples from September—December the 1-ringed fish were North Sea autumn spawners. The young herring caught in pound-nets in the Aalborg bay during the summer were mixtures of North Sea autumn spawners and local coastal spring spawners. The relatively low V.P. indicate that they are not Kobbergrund herring, which the

Table 45. Samples of 0- and 1-ringed Herrings from the Skagerak, Kattegat and Belt Sea in 1954.

Locality	Month	No. of Samples	Gear	Depth m.	Length- range cm.	Rings on Scales	V. S.	V. P.	K ₂
Skagerak-Northern Kattegat									
N. Kattegat.....	Febr.	1	T	41	9—15	0	56.36 175	23.98	14.79 182
NW. of Skagen.....	—	1	T	65	9—16	0	56.50 195	23.85	14.28 182
N. NW. of Skagen.....	—	1	T	95	17—26	1	56.95 118	24.17	13.87 114
Off Hirtshals—Off Göteborg..	March	5	T	45—66	{ 9—12 13—14	{ 0 0	56.45 203 56.65 264	23.88 24.01	14.68 378 14.23 416
Off Hirtshals—E. of Læsø...	May-Dec.	11	T	24—136	9—18	0	56.50 830	23.66	14.74 441
Off Hirtshals—Skagen.....	July-Aug.	2	T	103—136	13—18	1	56.74 73	24.10	14.29 56
— — — — —	Aug.	1	T	30	14—17	1	56.33 58	23.76	14.53 51
Off Frederikshavn—at Skagen	Sept.-Dec.	5	T	30—45	17—18	1	56.58 73	23.84	14.71 75
Central and Southern Kattegat									
At Hals.....	July	8	P	—	11—18	0	56.35 593	23.88	14.81 151
N. of Djursland.....	July-Aug.	4	P	—	9—14	0	56.36 758	24.01	14.67 339
E. of Djursland.....	May	1	T	40	{ 10—14 15—17	{ 0 0—1	56.42 32 56.00 52	23.84 24.69	— — — —
NW. Seeland.....	Nov.	1	T	—	17—22	1—(2)	56.21 152	23.97	14.37 150
N. Seeland.....	Dec.	1	T	—	16—22	1	56.27 169	23.89	14.34 163
Samsø Belt-Great Belt									
Great Belt.....	Jan.	1	T	22	9—16	0	55.99 178	24.03	14.34 180
Aarhus Bay.....	Jan.-Febr.	2	T	40	9—17	0	56.11 292	24.22	14.33 274
— — — — —	April	2	T	18	11—15	0	56.35 256	23.85	14.48 233
Aarhus Bay—N. of Fyn.....	Apr.-May	3	T	16—25	9—18	0	55.88 184	24.07	— —
— — — — —	May	1	T	16	18—23	1—2	56.25 75	23.88	14.30 60
N. of Fyn.....	—	1	T	25	11—15	0—1	56.35 69	24.00	14.16 68
Great Belt.....	June-July	2	T	20	10—20	0—1	56.16 296	24.20	14.16 129
— — — — —	Oct.-Nov.	2	T	20	9—16	0	56.09 348	23.79	14.24 215
N. of Fyn.....	Dec.	1	T	12	7—13	0	56.15 177	23.71	14.40 181
Little Belt									
N. of Als.....	Jan.	1	T	35	10—17	0	55.70 179	24.59	14.13 181
— — — — —	March	1	T	35	9—16	0	55.64 199	24.18	14.14 160

In *italics* lies: number of herring. Gear: T = Trawl; P = Pound-net.

V.S. and K₂ might indicate, and this example again emphasizes the importance of using the V.P. in order to avoid serious mistakes in the interpretation of the results of the racial characters of herring samples.

In a trawl-caught sample E. of Djursland we meet the same mixture, but here the largest seem to be pure Kattegat coastal autumn spawners.

Samples from November–December from north of Seeland consisted of the northern Kattegat deep-water winter or spring spawners. The interesting fact that their stomachs were filled with *Meganyctiphanes*, which normally do not occur here, indicates that the herring are carried to this region by a strong inflow in the deeper water layers.

In the Samsø Belt (the northernmost part of the Belt Sea) and the Great Belt the young herring from January–February were local coastal autumn spawners mainly from the Belt Sea, but some were of the race which mostly spawns at the Kattegat coasts but sometimes also at the northernmost Belt Sea coasts.

In the rest of the year the samples were partly of the same local autumn spawners, partly of the Kattegat and Belt Sea coastal winter and spring spawners, in some of the samples mixed with North Sea autumn spawners, in others with the Kobbergrund herring.

In the Little Belt two samples from January–March were pure Belt Sea coastal autumn spawners.

In some recent years there have been indications of the reappearance of the local autumn spawners, and the many young fish of this race in the Belt Sea in 1954 is an extremely important fact, in that we may now expect a real reappearance of the autumn fishery for herring for consumption in these waters. This

fishery has been very poor since the disappearance of the stock on account of the cold winters 1939–42. As predicted in former volumes of Ann. Biol. it has actually improved a little during recent years, but 1954 is the first year the local autumn spawners have appeared in great quantities among the young herring of the region. Their size in the spring was about 12–13 cm.

Adult Herring.

Kattegat, Belt Sea and Baltic.

In the Skagerak the main part of the catch during the winter fishery consisted of spent and recovering spents of the North Sea autumn spawners but the catches of young immature fish contained a great proportion of spring spawners of the Kattegat deep-water “winter herring” or of the Atlanto-Scandian type (cp. Table 46). Some almost mature, fully mature and spents were of the same races, but some few in a sample from 18. January were perhaps coastal spring spawners.

In a sample in May from E. of Læsø the recovering spents, which were the most numerous, were Kattegat coastal winter spawners. The other maturities were poorly represented but the immature fish might seem to be mostly North Sea autumn spawners.

Mature pound-net herring from North Seeland were typical Belt Sea coastal spring spawners whereas the immature and spents were mostly coastal winter spawners.

A sample of pound-net herring from SW. Fyn caught in April were typical local spring spawners. A sample of trawl-caught herring from Bornholm in September were spring spawners (cp. Table 46).

AAGE J. C. JENSEN.

Table 46. Racial Characters of Herring caught for Consumption in the Skagerak, Kattegat, Belt Sea and Baltic.

Locality	Date	Gear	Depth m.	Maturity	V. S.	V. P.	K ₂
N. of Skagen	8/1	T	94	I—III, VII—VIII	56.50 166	23.84	14.65 163
—	18/1	T	175	I—II, VII—VIII	56.37 84	23.87	14.37 82
NE. of Læsø	23/1	T	255	I—III, VII—VIII	56.59 91	23.68	14.48 90
N. of Skagen	25/1	T	160	I—III, VII—VIII	56.84 164	24.07	13.93 159
—	25/1	T	218	I—III,	56.65 40	24.08	14.35 40
—	25/1	T	218	VII—VIII	56.48 42	23.87	14.62 42
N. of Skagen — E. of Læsø	8/1—25/1	T	94—218	IV—V—VI (—VII)	57.19 27	23.69	14.56 27
N. of Skagen	6/2	T	94	I—III, VII—VIII	56.84 164	24.07	13.93 159
N. of Seeland	27/4	P	—	I—III, VII—VIII	56.00 54	23.63	14.29 52
—	27/4	P	—	IV—VI	55.78 121	23.45	14.07 118
SW. of Fyn	24/4	P	—	IV—VIII	55.90 157	23.57	14.05 149
At Bornholm	24/4	T	68	I—VIII	55.35 178	23.64	13.88 174

In italics: number of herring.

Gear: T = Trawl; P = Pound-net.

Table 47. Distribution according to Size (%).

Date	Centimetres																	Number examined
	13	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
3.—10. June.....	—	0.7	1.1	3.4	6.3	22.7	25.6	20.4	10.9	3.6	1.6	1.1	1.1	0.7	0.2	0.2	0.2	442
17.—21. June.....	—	0.1	1.4	6.7	7.7	37.8	35.0	6.7	2.4	0.5	0.5	1.0	—	—	—	—	—	209
28. June—1. July..	0.3	0.5	1.3	1.8	9.8	17.1	26.6	20.4	9.3	6.2	3.6	1.6	1.0	0.3	—	0.3	—	387

Preliminary Results of the Herring Investigations in the Bothnian Sea 1954.

In Tables 47—52 some records are given on the stock of herring in the middle part of the Bothnian Sea. The herrings here dealt with were caught partly in a herring trap and partly in a pelagic trawl.

Trap catches.

The herring trap was situated at the fishing vilage of Skatan (position 62°11.5' N., 17°32'E.). Herrings from 13 different catches during the period 3. June—1. July were examined. Table 47 gives a survey of the size distribution of 1038 herrings.

The age of 565 herrings was determined by means of the scales. Table 48 does not give an exactly true picture of the age composition of the catches. On account of greater difficulties in reading the scales from older than from younger herrings, the figures for the former are too small. In the age-groups 2—6 years it was impossible to determine correctly the age of 3.7% of the herrings and in the age-groups 7—12 years the age was uncertain in 27.8%. These doubtful ones are not included in the table.

The major part of the catches consists of the year-classes 3, 4 and 5 years old. The year-classes 6, 7, and 8 years old were poorer than the 9-year-olds.

During the period 17.—21. June the herrings were younger and smaller than in the other two periods (Table 47).

The maturity stage was determined in 998 herrings.

During the period 3.—10. June the major part of the herrings analysed was in stages VI—(VII—II). Later on, however, most of the herrings were in stages II—V.

Table 49. Distribution according to Maturity (%).

Date	Maturity stages								Number exam.
	I	II	III	IV	V	VI	VII	VII-II	
3.-10. June	0.5	2.1	2.5	24.9	11.6	41.6	15.8	1.1	438
17.-21. June	—	—	—	—	—	—	—	—	—
	2.0	3.4	3.4	58.5	16.6	11.7	2.9	1.5	205
28. June-1. July	—	0.3	0.6	54.4	20.8	14.1	8.5	1.4	355

The number of vertebrae was determined on 1023 herrings.

Table 50. Distribution according to Number of Vertebrae (%).

Date	Number of vertebrae					Mean value	Number examin
	54	55	56	57	58		
3.-10. June	5.0	43.5	43.2	8.3	0.0	55.55 ± 0.034	435
17.-21. June	—	—	—	—	—	—	—
	8.7	58.0	27.5	5.3	0.5	55.31 ± 0.050	207
28. June-1. July	6.0	47.0	40.2	6.3	0.5	55.48 ± 0.037	381

The table shows that the number of vertebrae in the herrings from 17.—21. June is considerably lower than in the other two periods. In Table 51, the average size and number of vertebrae have been calculated separately for each year-class.

Table 51. Average Length and Number of Vertebrae in different Year-Classes of trap-caught Herring.

Brood-Years	Winter-Rings	Length cm.	V.S.	Number examined
1952.....	1	16.3	55.11 ± 0.201	17
1951.....	2	18.9	55.27 ± 0.066	108
1950.....	3	19.3	55.46 ± 0.060	144
1949.....	4	20.1	55.45 ± 0.073	106
1948.....	5	20.5	55.43 ± 0.109	35
1947.....	6	20.8	55.37 ± 0.129	30
1946.....	7	21.2	55.61 ± 0.133	36
1945.....	8	21.6	55.93 ± 0.109	46
1944.....	9	22.3	55.50 ± 0.167	24

Table 48. Distribution according to Age (%).

Date	Years										Number examined
	2	3	4	5	6	7	8	9	10	> 10	
3.—10. June.....	3.7	15.3	25.9	9.7	6.0	6.0	8.8	13.4	7.4	3.7	216
17.—21. June.....	3.5	33.3	25.5	22.0	6.4	4.3	2.1	1.4	0.7	0.7	141
28. June—1. July ..	1.9	13.9	26.4	26.0	6.3	5.3	6.7	7.2	3.8	2.4	208
Total.....	3.0	19.3	26.0	18.8	6.2	5.3	6.4	8.1	4.4	2.5	565

We find that there is a very strong variation in the mean vertebral counts for different year-classes. The year-classes born in 1951, 1952 and 1947 show low mean values but the year-classes born in 1945 and 1946 high ones.

Pelagic trawl catches.

During the period 22. July—19. August a series of 15 pelagic trawl hauls were made along the Swedish coasts of the middle part of the Bothnian Sea. The hauls were performed at night with a trawling depth of generally 10—30 metres.

The figures below give a survey of the size distribution (%) of 1242 herrings.

cm.....	11	12	13	14	15	16	17	18
%.....	0.3	2.4	3.9	2.7	5.2	8.5	20.3	24.5
cm.....	19	20	21	22	23	24	25	26
%.....	14.1	8.5	4.9	2.6	1.2	0.3	0.6	0.2

We find that the herrings caught by pelagic trawl are smaller than those caught in the trap.

A very small part of the herrings were in the maturity stages III—VI, viz. only 2.3% and the rest in stages VII—(VII—II) and I—III as the following figures show:—

Maturity...	I	II	III	IV	V	VI	VII	VII-II
%.....	6.2	71.1	1.7	0.0	0.3	0.3	5.9	14.6

The number of vertebrae was determined in 515 herrings, and the distribution was as follows:—

No. of Vert...	53	54	55	56	57	Mean
%.....	0.4	11.7	52.4	30.9	4.7	55.28 ± 0.033

In Table 52 the average length, average number of vertebrae and year-class composition are calculated for 197 herrings with readable scales.

Table 52. Age Composition, average Length and average Number of Vertebrae in different Year-Classes of pelagic trawl-caught Herring.

Brood-Years	Winter-Rings	%	Length cm.	V.S.
1952.....	1	0.5	—	—
1951.....	2	1.0	—	—
1950.....	3	7.6	18.0	55.27 ± 0.199
1949.....	4	17.8	18.3	55.11 ± 0.105
1948.....	5	18.8	18.4	55.11 ± 0.131
1947.....	6	15.2	19.2	55.10 ± 0.136
1946.....	7	13.7	19.6	55.19 ± 0.129
1945.....	8	13.2	19.9	55.58 ± 0.124
1944.....	9	6.6	—	—
1943.....	10	3.0	—	—
<1943.....>10	2.5	—	—	—

Table 52 shows that the year-class composition is different from that in the trap catches. The distribution among the year-classes born in 1945—1950 is more even. The 7-year-old class is thus not as small, comparatively, as in the trap catches.

The average length figures are very much smaller than the corresponding figures for the trap catches. In other words the herrings caught in the trap show a higher growth-rate than the trawl-caught fish.

Also the mean vertebral counts for each year-class are smaller than corresponding figures for the trap catches but there is a similar variation.

As for the trap herrings, those born in 1948 show a comparatively low value and those born in 1945, a high one.

It is possible that the spring- and summer-spawning herrings of the middle part of the Bothnian Sea consists of two or more races. The figures above indicate that there exists a herring type (or types) with comparatively rapid growth-rate and a comparatively high number of vertebrae on the one hand and on the other a herring type (or types) with a slower growth-rate and a lower number of vertebrae.

Tagging experiments.

During the period 3. June—1. July, 500 herrings were tagged with the Lea hydrostatic tag.

The tagging was carried out on 12 different days from the research vessel "Eystrasalt". The live herrings were collected from the herring trap at Skatan (partly from the same catches as those examined, Tables 47—51).

The tag was fixed between the head and the dorsal fin by means of a bridle and pin of stainless steel. The lengths of the herrings were measured and scale samples were taken for age determination.

The tagged herrings were transported to Hundgrund about 10 naut. miles ESE. from Skatan where they were liberated.

Up to the present (11. February 1955) 53 herrings have been recaptured, that is, a little more than 10%.

The last one was captured on 8. January 1955, at Skatan, 193 days after liberation.

Most of the recaptures have been made within a comparatively short distance from the place of liberation. Twelve were captured within 10 naut. miles, thirty-one between 10



Figure 24. Localities of recaptures in the Bothnian Sea.
+ Place of liberation. ● Place of recapture.

and 20 naut. miles and eight between 20 and 50 miles from this point. (Figure 24).

One of the tagged herrings was captured

after 51 days at Margrund 1' W. of Kristinestad, Finland, 100 naut. miles from the place of liberation and another after 58 days 70 miles away at Utnallen ($60^{\circ}56.1'N.$, $17^{\circ}45'E.$).

A surprisingly large part of the recaptures, not less than 48% was made with gwyniad nets and gwyniad traps (which have very wide meshes) and only 38.7% with herring nets and herring traps. Presumably this depends on the fact that the bridle and pin with which the tag is attached to the herring is easily entangled in the meshes of the gear. Perch nets accounted for 7.7% of the recaptures and for 5.8% the mode of recapture is unknown.

The figures below give a survey of the age composition of the tagged and the recaptured herrings (determined on readable scales) together with a calculation of the percentages recaptured of each year-class.

	Years								
Age	3	4	5	6	7	8	9	10	> 10
Tagged	36	81	85	40	50	54	39	12	23
Recaptured	6	13	9	4	5	4	3	0	0
% recapt. of each year-class	17	16	11	10	10	7	7	0	0

The figures show that a much larger part of the younger than of the older herrings are recaptured. Possibly this indicates a difference in mode of life for different age-groups.

LENNART HANNERZ.

Sardine.

INTRODUCTION

Le présent rapport est constitué par les contributions apportées par les membres suivants:—

H. AURICH.....	Allemagne
G. DANNEVIG.....	Norvège
R. LETACONNOUX.....	France
F. NAVARRO et autres.....	Espagne
A. RAMALHO.....	Portugal

J. CUESTA.

YOUNG STAGES

Spawning of Pilchard and Anchovy in the Southern North Sea.

Since 1948 an intensive spawning of pilchard (*Clupea pilchardus*) and anchovy (*Engraulis encrasicolus*) has taken place in the southern North Sea caused by the climatic change developed during the last half century (AURICH, 1953¹). Previously the spawning areas of these species were generally limited to the Atlantic coasts of Europe and Africa and to the Mediterranean, reaching in the north-east to the Straits of Dover (pilchard) and to the Zuider Zee (anchovy), respectively. The latter species has also spawned off the east Friesian coast, but less intensively, and since 1930 in the north Friesian area also.

In continuation of the investigations on the change in density and distribution of pelagic fish fry, the R/V "Uthörn" carried out vertical sampling with the Hensen net in the southern North Sea between 3°30'E. and the west coast of Schleswig-Holstein from 29. May to 5. June and from 7.—14. July 1954. The results of these investigations are summarized in Table 1.

After a sudden rise in 1948/49 the spawning intensity of anchovy decreased in the following year, remaining constant until 1954 (average density about 200 eggs per square metre).

Table 1. Numbers per square metre of Anchovy and Pilchard Eggs in the Southern North Sea.

	Anchovy		Pilchard	
	average*)	maximum	average*)	maximum
1902—1929 (except the Zuider Zee)	—	2	no spawning	—
1930—1939	10	24	no spawning	—
1948.....	no quantitative investigations, numerous larvae in horizontal samples		south-western area	not investigated
1949 June	595	2367	—	—
July	502	3885	—	50
1950 June	177	996	—	276
July	202	807	78	234
1951 June	114	357	137	279
July	215	534	245	588
1952 July	209	891	182	648
1953 June/July	174	618	188	411
1954 May/June	100	273	79	177
July	262	882	567	1107

*) Average of all stations yielding more than 30 eggs per square metre.

Likewise there is no considerable change in the density of pilchard eggs. The increase in pilchard eggs shown in Table 1 is not to be mistaken as an increase in the spawning stock, it is conditioned by the cruises being expanded to the west in later years. It is noteworthy that the first invasion of pilchards and anchovies has taken place at the same time as the yield of the Portuguese sardine fishery decreased.

H. AURICH.

¹) H. AURICH, Helgoländer Wiss. Meeresunters., 4, 3, pp. 175—204. List (Sylt), 1953.

The Occurrence of Sprat Larvae in Norwegian Waters.

The Norwegian fishery for sprat takes place mainly in the Oslofjord and in the fjords of western Norway. According to SUND (1911),¹⁾ the sprat population in the coastal waters of western Norway is recruited from the spawning grounds in the Skagerak and adjacent waters. This theory was based on observations from 1903—10 on the occurrence of sprat eggs and larvae. During the following 40 years no systematic investigations were carried out to locate the spawning grounds and study the recruitment of the stock in our waters. However, in 1950 we began to study these problems more closely (G. DANNEVIG, *Ann. Biol.*, 8, p. 120).

In order to locate the spawning grounds we have made a systematic search for newly hatched larvae for 5 years. The plankton samples have been obtained by taking vertical hauls from 50 m. to the surface with a one-metre plankton net, one or two hauls at each station. This method is found to give quite good information on the relative abundance of sprat larvae in the various localities.

This report deals with the investigations which have been carried out in the fjords and the outer coastal waters between Oslo and Haugesund (Figure 1). In the open sea we have regularly worked a number of sections



Figure 1. Map of area investigated.

Table 2. Average Number of Sprat Larvae in a vertical Haul 50—0 m. with a one-metre Plankton Net.

District	1950	1951	1952	1953	1954
The outer coastal waters:					
South of Ferder.....	13.7	3.0	2.5	59.7	67.0
Larvik-Kristiansand..	13.0	1.1	6.6	33.7	18.2
Lindesnes-Egersund..	—	0.9	0.3	32.9	2.3
Stavanger-Haugesund	—	—	0.1	0.4	—
The fjords:					
Oslofjord.....	3.3	10.3	0.3	5.2	3.5
Larvik-Kristiansand..	2.3	2.9	—	3.7	7.0
Lindesnes-Egersund..	—	0.3	1.4	1.0	1.5
Stavanger-Haugesund	—	—	0.04	0.2	0.0

where stations have been taken at 5 naut. miles intervals, thus covering a distance of 25—30 n. m. from the skerries. The observations have always been made between the middle of May and the end of June, when the spawning in these waters is generally accomplished.

The results arrived at during 1950—54 can be seen in Table 2, which gives the average number of larvae per haul in each district. In the outer coastal waters the sprat larvae have generally been most numerous to the south of Ferder, and between Larvik and Kristiansand. In most years they have been less abundant between Lindesnes and Egersund. In 1953, however, we also found a great number at this latter part of the coast. Only a few larvae have been found on some stations off the coast of western Norway, the average catch being less than one larva. It should be noted that the larvae were most abundant in 1953, especially in the waters to the east of Egersund.

Sprat larvae have also been found to occur regularly in the Oslofjord and in the small fjords between Larvik and Kristiansand. Generally they are not so numerous here as in the offshore waters at the same part of the coast. In the fjords the catches also decrease from east to west. It is of special interest to note that very few larvae have been found in the fjords between Stavanger and Haugesund, where a very important fishery takes place.

These results seem to indicate that the sprat spawns regularly in the Oslofjord and in the coastal waters to the east of Kristiansand, whereas practically no spawning takes place on the western part of the coast.

G. DANNEVIG.

¹⁾ SUND, O. 1911. "Undersøkelser over brislingen i norske farvann". Aarsber. vedk. Norges Fiskerier.

COMMERCIAL FISH

La Sardine du Centre du Golfe de Gascogne en 1954.

En 1954, le début de la campagne sardinière a été caractérisé par la présence d'un stock normal en Mai-Juin dans la région comprise entre les îles d'Yeu et d'Oléron.

Ces sardines, d'une moyenne vertébrale de 52.30, avaient cependant une taille anormalement faible (130 mm.).

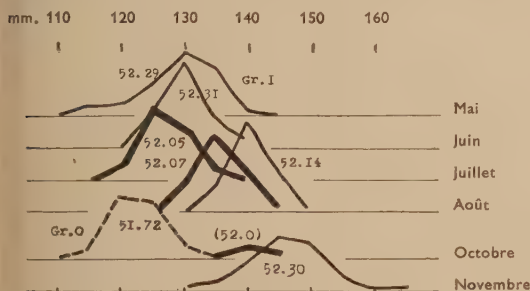


Figure 2. Distribution des tailles et moyennes vertébrales observées en 1954.

La fin de la campagne a été par contre perturbée par l'absence du groupe 0 armoricain et son remplacement par le groupe 0 cantabrique (moyenne vertébrale 51.72) et par la présence instable sur la pêcherie des groupes I armoricain et aquitanien. Les sardines de ce dernier type (moyenne vertébrale 52.06) paraissent encore peu nombreuses cette année.

R. LETACONNOUX.

La Sardine de Santander.

Notre dernière publication sur la sardine de Santander concerne les observations effectuées en 1951 (Ann. Biol., 8). Des circonstances adverses — parmi lesquelles la persistante crise de pêche n'a pas été la moins gênante — ont empêché dans les années successives l'étude régulière de l'espèce. L'échantillonnage s'est réduit à deux lots en 1952, huit en 1953 et trois en 1954.

Malgré la pauvreté du matériel nous croyons convenable de publier en résumé les nouveaux résultats acquis, seulement sous les aspects qui nous semblent les plus intéressants (Tableau 3).

1) La fréquence des stades de maturité ainsi que le poids moyen des gonades dans les échantillons montrent que deux pontes

annuelles ont eu lieu en 1952 et en 1953, l'une au printemps et l'autre en automne. Les données pour 1954 sont bien plus incertaines.

2) En 1953 les sardines de printemps restèrent sur la pêcherie après la ponte. Agées d'un an révolu, elles croissent vite, passant de la taille modale de 15 cm. en Avril à celle de 17.5 en Septembre.

3) En fin d'été cette population disparaît pour faire place aux grandes sardines d'automne dont la taille modale est de 18 à 18.5 cm. (en Octobre 1954 elle est de 17 cm. seulement). Leur âge est de 24 mois environ. Elles sont à maturité avancée; le poids des gonades permet de supposer que la ponte massive s'est accomplie à la fin de l'année pour finir peut-être en Janvier.

4) Dans la pêcherie d'automne 1953 les grosses sardines étaient mélangées avec de petits poissons mesurant 11.5 à 15.5 cm. Les plus petits, à tailles peu dispersées autour du mode de 12.5 cm. et à sexe souvent indi-

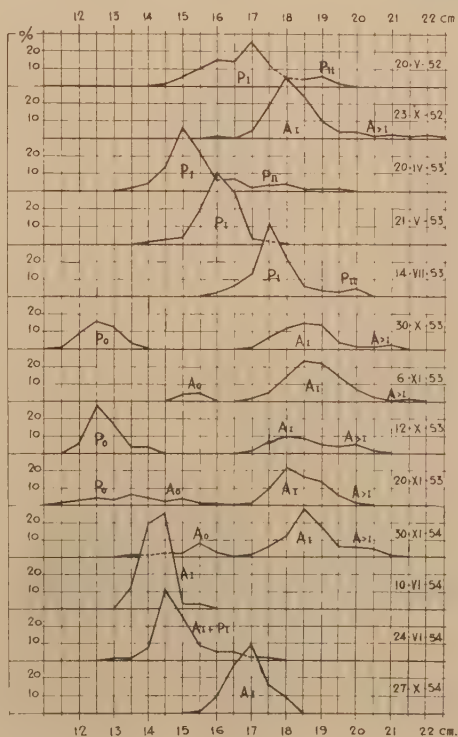


Figure 3. Santander: Taille et âge.
A, sardines d'automne. P, sardines de printemps.

Tableau 3. Sardine de Santander.

A) Tailles.

	1952		1953								1954		
Date.....	20-V	23-X	20-IV	21-V	14-VII	30-X	6-XI	12-XI	20-XI	30-XI	10-VI	24-VI	27-X
Taille mm. (%)													
115.....	—	—	—	—	—	1	—	—	1	—	—	—	—
120.....	—	—	—	—	—	9	—	5	3	—	—	—	—
125.....	—	—	—	—	—	16	—	28	5	—	—	—	—
130.....	—	—	—	—	—	13	—	17	3	—	—	1	—
135.....	—	—	1	—	—	4	—	4	6	1	12	1	—
140.....	—	—	4	1	—	—	—	4	4	1	39	14	—
145.....	1	—	13	3	—	—	—	—	2	2	45	41	—
150.....	5	—	36	4	—	—	4	—	4	2	2	25	—
155.....	10	—	21	19	—	—	5	—	1	8	2	8	1
160.....	15	1	6	40	2	—	—	—	1	3	—	4	10
165.....	14	—	7	29	6	—	—	—	—	—	—	4	27
170.....	26	4	2	3	13	1	2	1	1	1	—	1	39
175.....	11	19	3	1	41	7	5	7	9	6	—	1	15
180.....	7	35	4	—	23	12	14	10	22	12	—	—	8
185.....	4	24	1	—	6	15	23	9	17	28	—	—	—
190.....	6	9	1	—	3	14	22	5	14	18	—	—	—
195.....	1	3	1	—	2	4	15	4	6	6	—	—	—
200.....	—	3	—	—	4	1	7	5	1	6	—	—	—
205.....	—	—	—	—	—	1	2	1	—	5	—	—	—
210.....	—	1	—	—	—	2	—	—	—	1	—	—	—
215.....	—	—	—	—	—	—	1	—	—	—	—	—	—
220.....	—	1	—	—	—	—	—	—	—	—	—	—	—
N.....	100	100	100	100	96	100	100	100	87	100	100	92	99

B) Maturité.

Stades (%)													
I.....	—	—	—	—	—	43	—	48	11	—	97	48	4
II.....	17	—	—	—	—	1	8	11	11	6	3	51	51
III.....	9	—	—	6	—	2	9	3	1	7	—	1	30
IV.....	68	3	1	1	—	41	55	13	14	3	—	—	12
V.....	6	11	—	3	—	12	22	21	43	12	—	—	3
VI.....	—	70	49	29	—	1	6	2	19	67	—	—	—
VII.....	—	12	28	10	39	—	—	2	—	5	—	—	—
VIII—II.....	—	4	22	51	61	—	—	—	—	—	—	—	—
Poids moy.													
ovaires, g.	2.15	2.12	1.04	0.49	0.27	1.69*	1.85	1.16*	3.88	1.65	—	—	—
testicules, g.	2.05	1.59	1.95	0.46	0.10	1.27*	1.39	1.06*	2.59	1.98	—	—	—

C) Moyenne Vertébrale.

50.....	2	1	4	2	—	3	1	2	2	—	—	—	—
51.....	4	18	17	18	10	11	16	18	14	16	11	7	17
52.....	70	65	48	39	54	57	68	57	56	64	73	67	57
53.....	22	15	10	39	25	20	15	13	5	16	16	17	24
54.....	2	1	—	2	—	—	—	—	—	—	—	1	1
Moyenne.....	52.18	51.97	51.81	52.21	52.17	52.03	51.97	51.90	51.83	52.00	52.05	52.13	52.09

* Petites sardines exceptées.

stinct (stade I), sont des sardines nées au printemps 1953. Les sardinettes un peu plus grandes (jusqu'à 16 cm.), à maturité II, III et IV, représentent la génération issue de la ponte de l'automne 1952; leur ponte aura lieu en fin de l'année ou en Janvier.

Il est à remarquer que la moyenne vertébrale des sardinettes de l'une et de l'autre provenance (51.93; n = 116) est à peu près identique à celle des grandes sardines (51.96; n = 338).

La fréquence bimodale ou plurimodale des

tailles en automne a été parfois notée en Santander, bien que son évidence et sa persistance soient plus remarquables en 1953.

5) La filiation des sardines étudiées en Juin 1954, dont la taille modale est de 14. cm. et le stade sexuel I ou II, reste inconnue. Sont-elles issues de pontes précoces de l'automne 1953? Proviennent-elles de pontes tardives de l'automne 1952? Nous sommes enclin à la dernière supposition quant au lot du 1 Juin. L'échantillon du 24 Juin est peut-être un mélange de sardines à origines diverse

6) La m. v. du matériel étudié en printemps est légèrement plus grande qu'en automne; excepté en 1954:—

Printemps	Automne
1952: 52.18 (n = 100)	51.97 (n = 100)
1953: 52.08 (n = 268)	51.95 (n = 454)
1954: 52.09 (n = 192)	52.09 (n = 99)

Cependant, les très fortes, fréquentes et irrégulières fluctuations de la m. v. constatées dans les échantillons étudiés en Santander au cours d'études de grande durée (1933, 1940—44, 1947—51) conseillent de considérer avec prudence les résultats acquis en 1952—54. Pour la solution de ce problème durable on peut dresser les hypothèses les plus diverses et les plus contradictoires.

7) Sur la Figure 3 est suggérée la caractérisation de notre matériel quant à l'âge. Nous n'avons pas étudié les écailles, mais il est à présumer que le taux de croissance de la sardine de Santander est le même qu'au Portugal et en Galice. Il est à prévoir que pour la plupart des sardines nées en automne la première marque ne se formera sur les écailles qu'à la fin du deuxième hiver de leur vie, quand les poissons sont âgés de 14 à 16 mois.

F. NAVARRO, R. FERNANDEZ,
J. CUESTA.

La Sardine de la Côte du Portugal en 1954.

Pêche.

La production totale de la pêche de la sardine en 1954 a été de 115,000 tonnes, ce qui correspond à une augmentation de 42% sur les chiffres de 1952 et 1953, qui ont été de 81,000 environ. Le port de Leixões (près de Porto) a reçu, à lui seul, 40% du total de la sardine débarquée; Setúbal et Portimão se rangent à la suite avec environ 10% chacun. Comme l'année précédente, la pêche a été plus productive pendant les mois d'Août à Décembre, période à laquelle correspondent 85% du total annuel (93% à Leixões).

Matériel recueilli.

Les observations ont été effectuées, comme les années précédentes, à:— 1) Leixões, sur 44 échantillons hebdomadaires avec 8,000 sardines environ (observateur, J. MACHADO CRUZ, au Laboratoire de Zoologie Maritime de l'Université de Porto); 2) Lisbonne, sur 74 échantillons avec plus de 12,000 poissons (observateurs, A. M. RAMALHO, J. SANTOS PINTO,

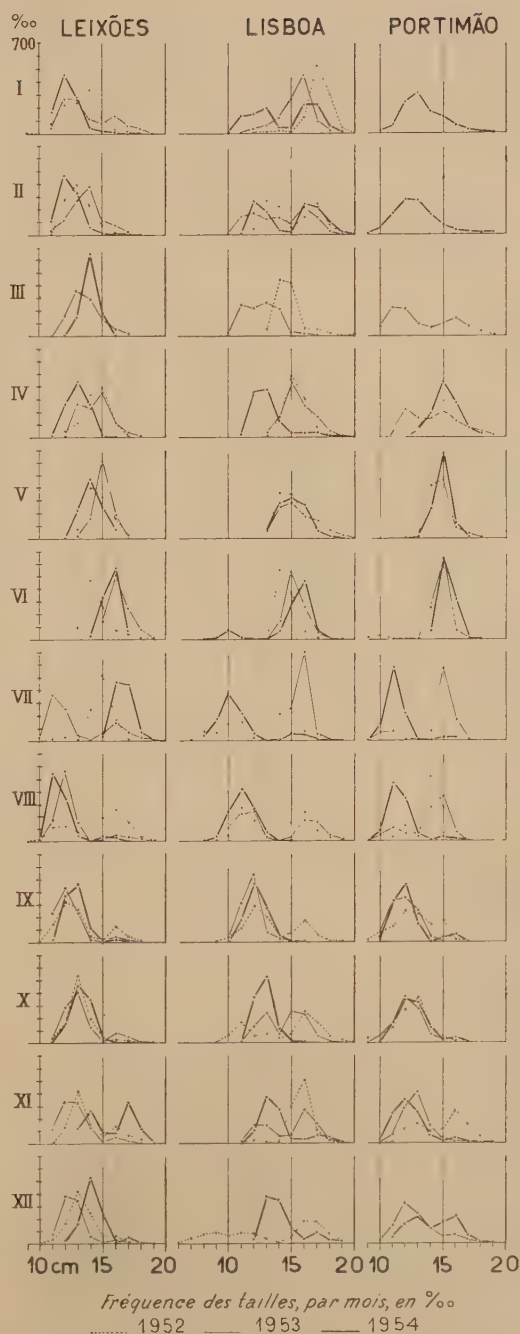


Figure 4. Fréquence des tailles (classes de 1 cm.) par mois, en ‰.

IVONE BARRACA et PEDRO GRAÇA, à l'Institut de Biologie Maritime); 3) Portimão, sur 248

échantillons (de 100 sardines) recueillis tous les jours de pêche (observateur J. Luis, à l'usine de conserves de poisson de M. ANTÓNIO FEU). En plus de ces échantillons réguliers on a aussi examiné d'autres recueillis éventuellement sur le poisson débarqué à S. Pedro de Muel (1 avec 147 sardines), Peniche (4—340), Sesimbra (1—100) et Vila Real de Santo António (2—315).

Taille.

La longueur que nous mesurons et enregistrons est celle comprise entre le bout du museau et la fourche de la nageoire caudale; elle correspond à 0.90 de la longueur totale, caudale comprise. La Figure 4 montre le résultat des observations faites en 1952, 1953 et 1954, à Leixões, Lisbonne et Portimão, sous la forme de graphiques des fréquences mensuelles des tailles groupées par classes de 1 centimètre.

En 1954, comme les années précédentes, la nouvelle génération de la sardine n'apparat dans le produit de la pêche qu'au milieu de l'année, vers la fin de Juin à Lisbonne, en Juillet à Portimão et en Août à Leixões. De Janvier à Juin, la pêche a apporté, presque uniquement, des sardines de la génération de 1953 qui formait la classe 0 jusqu'au mois de Mars et est devenue classe I à partir de cette date. Pendant le premier semestre la pêche a été assez réduite: 2,300 tonnes en Janvier, 1,000 en Février, nulle en Mars, 1,800 tonnes en Avril, 3,400 en Mai et 2,200 en Juin, soit 10,700 tonnes pour l'ensemble de ces six mois, contre les 104,400 du second semestre.

À Leixões le mode de la taille de Janvier à Avril (exception faite du mois de Mars, dont le seul échantillon n'est pas représentatif — provenant du produit de la pêche des filets dérivants) se place à 12/13 cm. À partir de Mai le polygone de fréquence des tailles se déplace graduellement vers la droite, au fur et à mesure de la progression de la croissance printanière de la sardine, et les modes atteignent 17 cm. en Juillet.

Pendant la même période les échantillons de Lisbonne manifestent quelques aspects différents. En effet, en Janvier et Février, il y a non seulement représentation de la génération de 1953 mais aussi, et dans une proportion presque égale, de celle de 1952 (modes à 12/13 et 16/17 cm. respectivement). À Portimão les polygones de fréquence sont plus ou moins semblables à ceux de Leixões.

La nouvelle génération (celle de 1954) fait son apparition dans le produit de la pêche avec une taille modale de 10 ou 11 cm. à partir du mois d'Août la production débarquée dans les trois ports a été presque totalement constituée par de la sardine de cette génération, la fraction formée par des sardines plus âgées ayant été généralement très petite.

En résumé: en 1954 la plus grande partie du produit de la pêche de la sardine a été obtenue aux dépens de la génération de l'année, environ 100,000 tonnes contre 15,000 de sardines plus âgées.

Croissance.

Dès le début des nouvelles observations systématiques sur la sardine à Lisbonne, vers la fin de l'année de 1951, on a cherché à obtenir le plus grand nombre possible de données sur la croissance, soit au moyen de mensurations directes de la taille, soit par l'examen des écailles, celui-ci étant plus limité dans son application en raison des difficultés pratiques de la récolte, de la préparation et surtout de la lecture des écailles de tous les exemplaires. Nous allons donner un résumé de certains aspects de la croissance pendant les deux premières années de la vie de la sardine, en utilisant les données dont nous disposons en ce moment relatives aux trois générations de 1951, 1952 et 1953.

Sur la Figure 5 sont représentées, pour chaque génération étudiée, les moyennes de la taille de la sardine au cours de l'année. Les petits cercles vides indiquent les moyennes pour la classe 0 obtenues par la mensuration directe des exemplaires et pour la classe I celles de l_1 calculées au moyen des écailles. Les cercles noirs représentent les moyennes de la taille de la classe I et les lignes pointillées qui relient les deux cercles du même échantillon indiquent l'accroissement respectif.

Les observations sur la génération de 1951 n'ont commencé qu'en Décembre et la classe 0 n'est représentée que par sept échantillons, dont le dernier est celui du 27 Février 1952. La taille moyenne dans ces échantillons varie entre 135 et 150 mm.; la moyenne générale étant de 140 mm. À partir du mois de Mars la génération de 1951 devient classe I. En Mars et Avril on constate une augmentation graduelle de la taille moyenne et de Δ_2 , les l_1 étant de l'ordre de grandeur des tailles observées dans les derniers échantillons de la classe 0. Mais à partir de Mai cet état de choses se

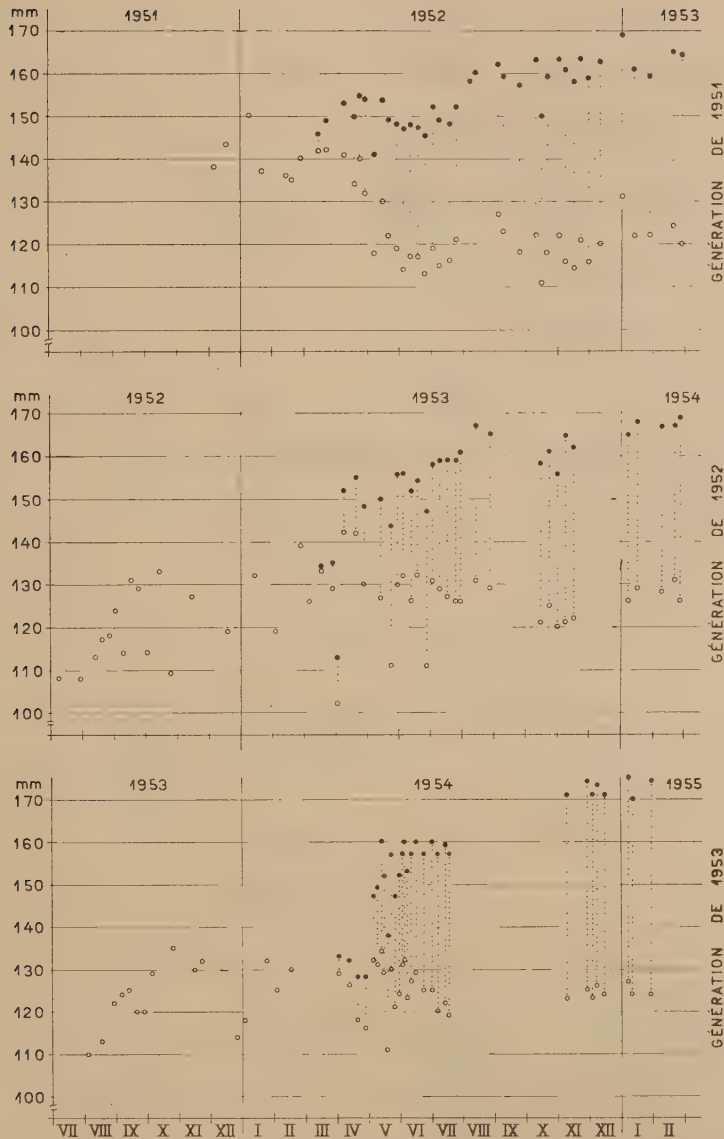


Figure 5. Croissance des trois générations indiquées classes 0 et I à Lisbonne.

modifie d'une façon remarquable; les valeurs de l_1 diminuent soudainement et se placent au niveau de 120 mm. auquel il se maintient jusqu'à Février 1953, époque à laquelle cette génération disparaît presque complètement dans le produit de la pêche. Ce changement de l_1 après le mois d'Avril est accompagné d'une diminution de la taille réellement observée, bien qu'il y ait une augmentation très marquée des Δ_2 , ce qui est caractéristique en

cette période de l'année. Pour expliquer cette variation soudaine, l'hypothèse se présente de la substitution d'une première sous-population plus âgée par une deuxième, plus jeune et plus nombreuse, qui se maintient accessible à la pêche jusqu'à sa disparition un an après.

Les sardines des générations de 1952 et 1953 apparaissent pour la première fois en Juillet-Août, avec une taille moyenne de 110 mm.

environ. Six ou sept mois plus tard (Mars de l'année suivante), à l'occasion de la formation du premier anneau d'hiver dans les écailles, la taille moyenne était de 125 mm.

Les six premiers échantillons de la classe I de la génération de 1952 diffèrent beaucoup les uns des autres; en effet, ceux des 16 et 27 Mars de 1953 présentent des tailles normales pour l'époque (134 et 135 mm. avec l_1 de 133 et 129 mm.), mais le suivant, celui du 31 du même mois, est constitué par de la sardine très petite (113 mm. avec un l_1 de 101 mm.); après cela les échantillons de 7, 17 et 25 Avril avaient de grandes sardines (tailles moyennes de 152, 155 et 148 mm. et l_1 respectivement de 142, 142 et 130 mm.). Dans les échantillons ultérieurs, à l'exception de ceux de 20 Mai et 24 Juin, (constitués par de petites sardines — 144 et 147 mm. avec un l_1 de 111 mm.), l'ensemble suit une évolution de la croissance assez régulière, avec des l_1 moyens qui varient entre 120 et 132 mm.

Dans la génération de 1953 on constate aussi des oscillations semblables, mais pas si prononcées, dans les premiers échantillons de la classe I. On voit donc que la période initiale de la classe I se présente avec une diversité de composition qui, comme nous l'avons déjà signalé pour la génération de 1951, nous semble être en rapport avec une alternance dans les sous-populations exploitées par la pêche, lesquelles proviendraient, très probablement, de pontes effectuées à des époques diverses, jusqu'au moment où il se fait une certaine stabilisation des l_1 moyens, qui dure jusqu'à la fin de la classe I en question.

La marche générale de la croissance de la classe 0 est représentée dans le graphique de la Figure 6. On constate qu'il y a une similitude assez nette pour la plupart des observations, particulièrement de Juin à Novembre. Toutefois, à partir de ce mois, en plus de la régularité générale, on remarque qu'il y a une dispersion assez considérable des points, avec des diffé-

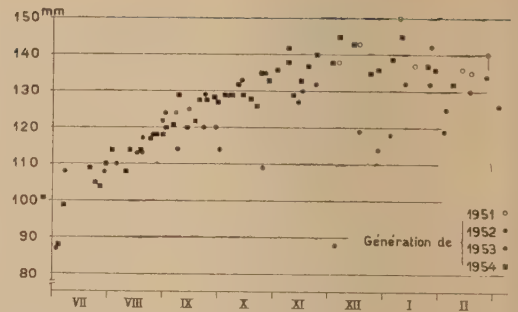


Figure 6. Croissance de la classe 0 des quatre générations indiquées (Lisbonne).

rences qui atteignent 20 mm. pour la même génération et de presque 40 mm. entre celle de 1951 et celle de 1953. En ne tenant pas compte de ces irrégularités, on voit dans le cas de la génération de 1954, dont nous disposons d'un plus grand nombre de données, une croissance rapide (45 mm.) de Juillet à Novembre, suivie d'un ralentissement, ou même arrêt d'accroissement en Décembre, Janvier et Février.

L'apparition d'échantillons de sardines de la classe 0 ayant des tailles inférieures à celles communes à la même époque n'est pas rare. Nous signalons les cas suivants. Dans la génération de 1952: l'échantillon du 24 Octobre avec une taille moyenne de 109 mm.; 17 Novembre et 3 Février avec 119 mm.; 4 Décembre avec 88 mm., celui-ci récolté exceptionnellement dans l'estuaire du Tage, au devant de Lisbonne. Dans la génération de 1953: échantillons du 27 Décembre avec 114 mm. et celui du 4 Janvier avec 118 mm.

Ces faits auront probablement une explication analogue à celle que nous avons suggérée au sujet des variations de l_1 au cours de l'année, c'est-à-dire, à la substitution temporaire des sous-populations exploitées à un certain moment par d'autres plus jeunes, qui, d'ailleurs, disparaissent très vite.

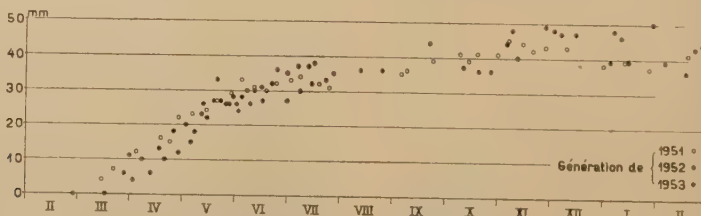


Figure 7. Croissance de la classe I des trois générations indiquées : valeurs de Δ_2 (Lisbonne).

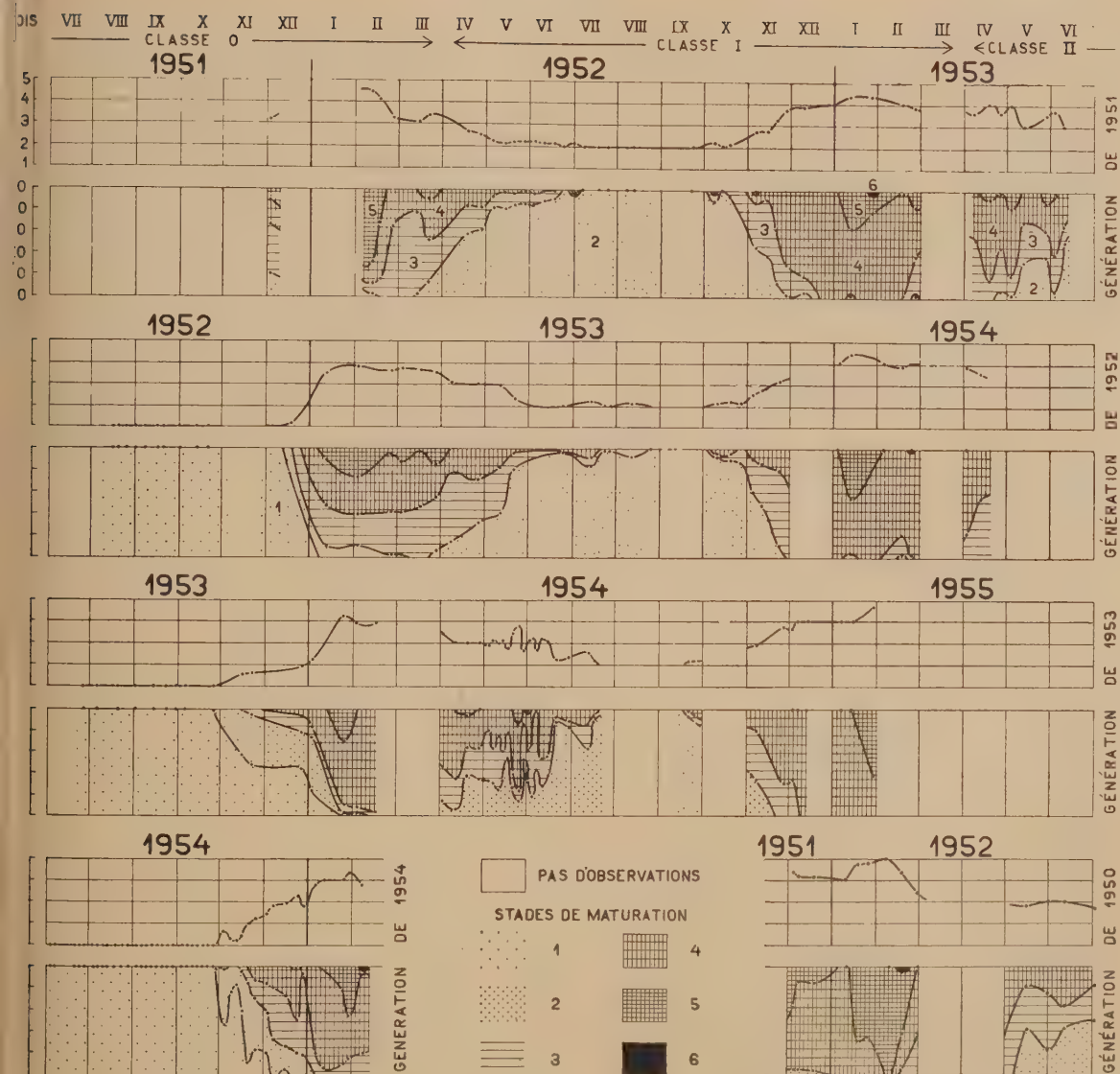


Figure 8. Cycles de l'évolution sexuelle des femelles des générations indiquées; variations de la moyenne et de la proportion des états de maturité (Lisbonne).

Pour ce qui a trait à la croissance de la classe I au cours de l'année, le graphique de la Figure 7 montre les valeurs successives de Δ_2 pour chaque échantillon examiné, des sardines des générations de 1951, 1952 et 1953, déterminés par l'étude des écailles. On voit que la croissance de cette classe débute au mois de Mars (époque de la formation du premier anneau) et se poursuit rapidement jusqu'à la fin de Juillet, date à laquelle les valeurs de Δ_2 atteignent

35 mm.; dans les 7 mois suivants, jusqu'à Mars de l'année suivante (formation du deuxième anneau) l'accroissement est très petit puisque, à cette date, les valeurs de Δ_2 sont situées entre 35 et 50 mm., selon les générations, c'est-à-dire un accroissement de 10 mm. au plus. Ce phénomène est semblable, dans ses lignes générales, à celui signalé par FURNESTIN (1945, p. 343 et suiv.), sauf dans la grandeur considérable dans le cas de la sardine de

Gascogne (presque 80 mm.), et dans sa durée, qui est aussi plus longue.

Maturité sexuelle.

La Figure 8 montre sous la forme de graphiques, les cycles de l'évolution sexuelle des femelles dans les générations de 1950, 1951, 1952, 1953 et 1954. Pour chaque génération le graphique montre, dans sa partie supérieure la variation de la moyenne des états de maturation des ovaires selon l'échelle usuelle (états I à VII) et dans sa partie inférieure la variation du pourcentage des différents états dans les échantillons successifs. La génération de 1950 n'est représentée que par une partie du deuxième cycle d'évolution et celle de 1954 par une partie du premier cycle, jusqu'à Février de 1955, époque à laquelle la ponte était déjà en train de s'effectuer.

D'une façon générale les premières phases de l'évolution sexuelle des sardines de la classe 0 débutent vers la fin d'Octobre-début de Novembre (dans la génération de 1952 un peu plus tard, à la mi-Décembre) et se développent rapidement jusqu'à atteindre les moyennes plus élevées vers la fin de Janvier, avec de nombreux poissons dans les états IV et V, les plus avancés qui se présentent dans les échantillons étudiés, puisque l'état VI n'a été observé que rarement, peut-être parce que les lieux de ponte sont au delà des lieux de pêche.

Cette situation se maintient pendant les mois de Février, Mars et la première moitié d'Avril (dans la génération de 1953 elle se prolonge, avec de nettes oscillations de composition, jusqu'à la fin de Juin) après quoi les états plus avancés de maturation sont presque disparus, la plupart des sardines se présentant dans l'état II (ou VII) pendant les mois de Juin à Septembre.

Le deuxième cycle de l'évolution sexuelle, lorsque les sardines sont dans la deuxième année de leur vie, s'initie en Octobre avec la réapparition des états III et IV, devient plus nette pendant les mois suivants et atteint le maximum en Janvier-Février, tant pour la moyenne que pour l'apparition des rares exemplaires dans l'état VI. Cette situation se maintient encore, d'après les observations fragmentaires dont nous disposons, pendant quatre mois, jusqu'en Juin ou même Juillet comme dans le cas du premier cycle d'évolution. À partir de cette époque le matériel d'observation devient encore plus rare, le nombre des

individus de la classe II devenant très réduit ou même nul.

Moyenne vertébrale (Tableau 4).

Les observations ont été poursuivies systématiquement sur le plus grand nombre d'échantillons possible, comme dans les deux années précédentes, à Leixões et à Lisbonne. En plus, on a fait des dénombrements dans quelques échantillons d'autre provenance, à savoir: sur la côte ouest, à S. Pedro de Muel (Lat. 39°45'N.) et Peniche (Lat. 39°20'N.); sur la côte sud, à Portimão (Long. 8°30'W.) et Vila Real de Santo António (Long. 7°31'W.). Les exemplaires examinés à ce point de vue sont au nombre de 6,863 de Leixões, 100 de S. Pedro de Muel, 400 de Peniche, 7,310 de Lisbonne, 700 de Portimão et 300 de Vila Real de Santo António, au total 15,673.

En 1954 les résultats des observations ont été un peu différents de ceux des deux années précédentes. Sans entrer, en ce moment, dans une analyse approfondie des faits, il faut signaler les aspects suivants:—

a) À Leixões les moyennes vertébrales des échantillons constitués par des sardines de la génération de 1953 sont nettement plus élevées

Tableau 4. Moyennes vertebrales, 1954.

Leixões					Lisbonne				
Mois	No. échan.	N	M	± Fl. M	No. échan.	N	M	± Fl. M	
I	3	466	51.40	0.10	4	400	51.20	0.10	
II	2	294	.45	.13	4	400	.21	.10	
III	1	200	.43	.16	—	—	—	—	
IV	2	323	.50	.12	4	500	.20	.09	
V	6	614	.43	.08	8	800	.24	.07	
VI	4	600	.41	.08	8	800	.13	.07	
VII	3	600	.36	.09	7	710	.13	.07	
VIII	4	767	.27	.07	7	700	.15	.07	
IX	4	800	.24	.07	9	900	.17	.06	
X	4	800	.34	.07	8	800	.18	.07	
XI	3	600	.34	.08	8	800	.16	.07	
XII	4	799	.27	.07	5	500	.12	.08	
Ann.	40	6,863	51.37		72	7,310	51.17		
S. Pedro de Muel					Portimão				
Date					Date				
16—XII	100	51.12	0.19		25—V	100	50.99	0.19	
					14—VIII	100	51.05	.18	
					20—VIII	100	.05	.17	
					3—IX	100	.10	.21	
24—VIII	100	51.12	0.19		27—IX	100	.10	.23	
6—IX	100	.12	.19		2—X	100	.14	.20	
19—IX	100	.26	.23		16—XII	100	.04	.20	
8—XI	100	.33	.20		Total...	700	51.07		
Total...	400	51.21							
Vila Real de S. António									
					22—VII	200	50.96	0.14	
					28—VIII	100	51.00	.19	
					Total...	300	50.98		

que celles de la génération de 1954. En effet, la moyenne générale a été de 51.43 pour celle-là et de 51.27 pour celle-ci. Cela se voit aussi dans le Tableau 4 (moyennes mensuelles), en comparant les valeurs pour le premier semestre (correspondant dans sa presque totalité à des sardines de la génération de 1953) avec celles du deuxième semestre qui correspondent, pour la plupart, à la génération de 1954.

b) À Lisbonne, les moyennes des échantillons se situent à un niveau inférieur non seulement à celui de Leixões pour 1954, mais aussi, bien qu'à moindre degré, à celui des années antérieures, à Lisbonne même. En effet, la moyenne générale est de 51.17 en 1954 et a été de 51.22 en 1952 et 1953.

Les échantillons de S. Pedro de Muel et de

Peniche ont des moyennes analogues à celles de Lisbonne.

c) Sur la côte sud (Portimão et Vila Real de Santo António) les moyennes sont très basses, de l'ordre de 51.00, inférieures donc à celles de 1953 (51.22) qui étaient analogues, d'ailleurs, à celles de Lisbonne pendant la même année.

Il semble donc que l'année 1954 se fait remarquer par des variations assez considérables des moyennes vertébrales tant pour chaque aire géographique comme entre les différentes aires (nord, centre et sud du Portugal) et, dans le cas de Leixões, même entre deux générations successives, ce qui sera un indice de plus de la diversité des sous-populations des sardines exploitées.

A. M. RAMALHO, J. S. PINTO
et collaborateurs.

Scombriform Fish.

INTRODUCTION

Reports to this new committee of the ICES have been received from the following countries:—

O. BAGGE Denmark.
R. KÄNDLER Germany.
A. REVHEIM Norway.
A. M. RAMALHO and J. S. PINTO Portugal.

F. FRADE.

YOUNG STAGES

SCOMBRIDAE

Distribution in the Kattegat and the Northern Belt Sea in June 1954.

In cooperation with "Institut für Meereskunde", Kiel (Prof. R. KÄNDLER) an investigation on the spawning of the mackerel in the Kattegat, the Belt Sea and the western Baltic has been carried out.

The Danish part of the investigation took place in June (10.—30.) and was carried out in the area north of the line Korsør-Nyborg-Fredericia with the research vessel "Biologen" and in the Sound with the motorboat "Havkatten".

Plankton samples from 32 stations taken by horizontal hauls with 2 m. ring-trawl and from 25 stations taken by vertical hauls with

the Hensen net were examined for fish eggs and larvae. With exception of seven stations in the Sound and the south-eastern part of Kattegat hydrographical observations were carried out on all stations ($^{\circ}$ T, $S^{\circ}/_{00}$).

The results are given in Table 1.

In the eastern part of the Skagerak and the NE. Kattegat large quantities of eggs were found (165,750 per hour—121 per m^2 . and 165,000 per hour—126 per m^2 .) rapidly decreasing towards the west to 1933 per hour and 30 per m^2 . at the east coast of Jutland. In the central Kattegat considerable quantities were found along the Swedish coast (124,500 per hour—79 per m^2 .) decreasing to 39,400 per hour—33 per m^2 . east of Fornæs. In the southern Kattegat the greatest numbers of eggs were found in the area north of the Great Belt

Table 1.

Date, June	N. Belt			S. Kattegat			C. Kattegat			N. Kattegat		Skagerak
	Sea	Sound		W.	E.		W.	E.		W.	E.	
	10-18	28-30	18-24	10-18	28-30	10-18	10-18	20-30	10-18	10-18	10-18	10-18
No. of stations.....	2	4	6	2	2	4	5	2	5	3	4	2
2 m. ring-trawl.....	?	2925	3910	3000	1088	1200	39,400	2000	124,500	1933	165,000	165,750
No. eggs/hour 2 m. ring-trawl.....	0	31	322	8	66	132	121	17	29	8	30	56
No. larvae/hour Hensen vertical.....	64	4	—	25	6	—	33	0	79	30	126	121
No. eggs/m. ² Hensen vertical.....	0	0	—	0	0.5	—	0.2	0	0.6	0	1.0	3
No. larvae/m. ² Mean temp. surface	13.2	12.5	—	15.0	13.9	—	12.2	12.4	15.2	11.8	14.6	14.7
bottom.....	4.5	5.6	—	9.1	5.5	—	5.9	7.0	5.7	5.9	6.9	7.4
Mean sal. surface.....	13.62	23.07	—	13.99	20.54	—	18.98	25.65	19.07	27.72	22.02	23.76
bottom.....	33.75	32.69	—	33.38	33.28	—	31.58	32.55	34.33	34.26	34.51	34.76

by means of horizontal hauls (3,000 per hour) against 1200 per hour in the eastern part of the area north of the Sound. The inverse result was obtained by means of vertical hauls (8 and 66 per m², north of the Great Belt—132 per m², north of the Sound).

In the southern part of the Kattegat 80% of the eggs were with a visible embryo which might indicate that most of the eggs have not been spawned in this area but originate from the NE. Kattegat.

In the Sound however, 90% of the eggs were without a visible embryo and might be spawned here.

The greatest number of larvae were found in the Sound (322 per hour) and in the south-eastern part of the Kattegat (132 per hour). In central Kattegat the greatest quantities of larvae were caught in the western part of the area (121 per hour), while the eastern part of this area corresponds to the eastern part of the northern Kattegat and Skagerak with 29.30 and 56 per hour.

The increase in number of larvae per hour towards the south in the eastern Kattegat and towards the west in the central Kattegat, must

be due to drift of early spawned eggs from the spawning centre in the north-eastern Kattegat.

The hydrographical conditions on the stations with a great number of eggs per m², and per hour are characterized by the presence of a distinct discontinuity layer between 15 and 20 m. At the east coast of Jutland north of Fornæs where very few or no eggs were present the bottom and the surface layer were mixed. The gradient for salinity and temperature from surface to bottom was only 4‰ and 3—5°C., while the gradient in the eastern Kattegat was 15‰ and 7—10°C.

O. BAGGE.

Distribution in the Great Belt, Kiel Bay, and Little Belt.

The average number of mackerel eggs per m² was 8 in June and 7 in July 1954, the means for 1934—43 were 1.5 and 0.2, respectively. The frequency of mackerel eggs in the Belt Sea in the middle of June (15.—18.) will be seen in Table 2.

The distribution of eggs demonstrates clearly that the spawning mackerel migrate from the

Table 2. Average Numbers of Mackerel Eggs and Larvae in the Belt Sea.

	Northern Great Belt	Southern Great Belt, incl. Fehmarnbelt	Northern Kiel Bay, incl. entrance to Little Belt between 55°10' and 54°35'N.	Southern Kiel Bay	Little Belt
	N. of 55°10'N. E. of 10°15'E.	S. of 55°10'N.		S. of 54°35'N.	N. of 55°10'N. W. of 10°15'E.
No. of stations.....	4	6	4	3	6
Eggs per m. ²	24	28	33	3	0.4
Larvae per m. ²	4	1	0	1	0
Eggs per 1 hour.....	3580	7380	7730	2870	460
Larvae per 1 hour.....	50	5	0	2	0

Kattegat through the Great Belt southward entering the Fehmarnbelt and the Kiel Bay, where they move towards the coast and enter the Little Belt also. In the inner part of the Little Belt, horizontal hauls only showed the presence of mackerel eggs. The progress of spawning during this movement can be seen from the percentage of eggs in which the embryo has already been formed: it decreases from 26—45% in the northern part of the Great Belt to 5—12% in the southern part, and

2—3% in the north-western part of the Kiel Bay.

Because of the earlier spawning, mackerel larvae were observed mostly in the Great Belt (with a maximum of 8 per m.² off Lillegrund). In horizontal hauls a total of 39 larvae from 4—11 mm. in length were found, the majority of which were caught in the northern part of the Great Belt, one only in the Kiel Bay, and none in the Little Belt.

R. KÄNDLER.

COMMERCIAL FISH

Tagging Experiments on Mackerel in Norwegian Waters.

In 1950 we carried out some experiments in order to see if the mackerel might be tagged without influencing the vitality of the fish (A. REVHEIM, 1951). The results proved to be very promising, and tagging experiments on mackerel have, therefore, been carried out in the years following.

The mackerel used for our experiments have generally been caught by an ordinary beach-seine, from which a few hundred fish were transferred to a live-net. In such a net the mackerel may be kept for several days, or even weeks. Several types of tags have been tried. Since 1952, however, we have exclusively used a cylinder of Alcatene film, which is fixed dorsally by a stainless steel wire, or by a loop of nylon line. The tags, and instruments used for attaching them, are shown in Figure 1.

These experiments have been carried out in Western Norway, where fish have been liberated in some fjords as well as between the

Table 3. Tagging Experiments in Western Norway 1950—54.

Year	Locality	Number tagged	Number recaptured		
			In the year when tagged	later	
			No.	%	
1950	Fjords.....	559	281	50	0
1951	Outer skerries.....	1001	238	24	11
	Fjords.....	1037	174	17	3
1952	Outer skerries.....	650	19	3	0
	Fjords.....	1144	195	17	2
1953	Outer skerries.....	1199	54	5	7
	Fjords.....	480	157	33	6
1954	Outer skerries.....	1156	252	22	—
	Fjords.....	700	151	22	—

outer skerries. Most of the fish tagged in the fjords belong to the I- and II-group, whereas the experiments between the skerries exclusively comprise mature mackerel.

It will be seen from Table 3 that a large number of fish has been recaptured, most of them within 2 or 3 months after tagging. Some specimens have, however, been retaken after more than 3 years (the experiments between the outer skerries in 1951).—The young mackerel which have been liberated in the fjords have not proved to undertake any extensive migrations. Most of them have been retaken in the same district.—Some of the mature fish are regularly recaptured in the North Sea, in the Skagerak, and in the Kattegat. A single specimen has even been taken in the Baltic. These experiments have, therefore, given valuable information on the migrations of the mackerel which occur in the coastal waters of western Norway during summer.

It was desirable to carry out tagging experiments also in offshore waters. In 1954 we succeeded in tagging 1739 fish off the south-eastern coast of Norway, where an important fishery for mature mackerel takes place during

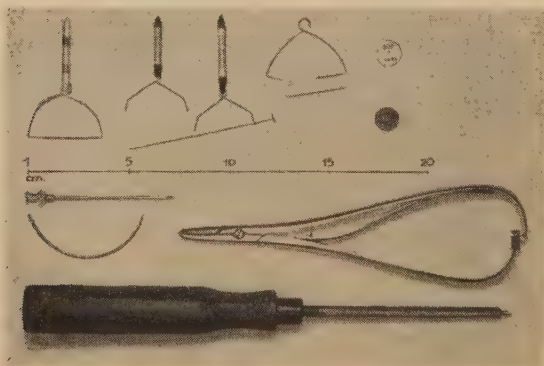


Figure 1.



Figure 2. Tagging experiment in the Skagerrak 1954.

Open symbols: tagging localities.

Black symbols: localities of recapture.

early summer. The experiments were carried out between 24. May and 10. June on board R/V "G. M. Dannevig". The mackerel was caught by trolling. Immediately after capture the fish were transferred to tanks with circulating sea water. When keeping the fish for some time in this way, it was easy to take out those which had been severely injured. A number of tagged and untagged fish were kept in the tanks for 10 hours. The mackerel seemed to stand the handling remarkably well. When liberated, the fish always disappeared very quickly.

The experiments were carried out in two localities, viz.: 5—15 naut. miles to the south-east of Arendal, and 10—15 nautical miles south-west of Ferder (Figure 2). 21 fish, or 1.2%, have been retaken up to 20. September 1954. The percentage number of recaptures is, therefore, considerably smaller than for the experiments in the coastal waters of Western Norway. At present it is impossible to say if this difference is to some extent due to the fact that the fish have been caught in a different way. The fishing intensity in the fjords may be quite different from that in the open sea, and we have not been able to carry out comparative experiments with mackerel caught by trolling and with a seine.

The total number of recaptures has been plotted on the map shown in Figure 2. It will

be seen that the mackerel after spawning undertake long migrations. A number of fish have been retaken in the Kattegat as well as in the North Sea during summer and autumn. A single specimen had been out for more than 3 months when caught. These results seem to indicate that mackerel caught by trolling may be used with success for tagging. Evidently experiments in the open sea are of great importance for our studies of the migrations of this species.

ARNE REVHEIM.

Reference.

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CARANGIDAE

Note sur la Croissance de *Trachurus trachurus* (L.) pendant la Première Année.

Nos connaissances sur la croissance et l'âge du chinchard (*Trachurus trachurus*) sont encore fragmentaires et parfois discordantes. L'observation des écailles et des otolithes n'a pas donné des résultats satisfaisants à LETACONNOUX (1951, p. 46), mais LOZANO CABO (1952, p. 36) écrit qu'il a rencontré des aspects dans des écailles d'un certain nombre d'exemplaires, auxquels il a attribué la signification de «lignes annuelles»; il les a comptés et a même mesuré les distances qui les séparent du centre de façon à déterminer les valeurs de l_1 , l_2 , etc. Toutefois, les figures que cet auteur publie (p. 100) ne sont pas assez nettes à cet égard et les données numériques qu'il enregistre dans son Tableau 7 (p. 100), font penser, surtout en raison de la très grande amplitude de variation dans chaque classe d'âge (95 et 207 mm. pour l_1 , par exemple), qu'en réalité la lecture des «anneaux d'hiver», même quand elle est possible, serait difficile et très aléatoire. Nous-mêmes avons fait des examens préliminaires d'écailles, d'otolithes et d'autres os plats, tels que ceux de l'opercule et de la crête du supra-occipital, et n'avons pas observé des images satisfaisantes à ce point de vue. Nous inclinons donc à croire que le chinchard ne se prête point à cette méthode pour la détermination de l'âge et de la croissance.

Tout comme LETACONNOUX (1951, p. 46) nous recourûmes alors à la méthode de Petersen, en nous limitant, pour commencer, à

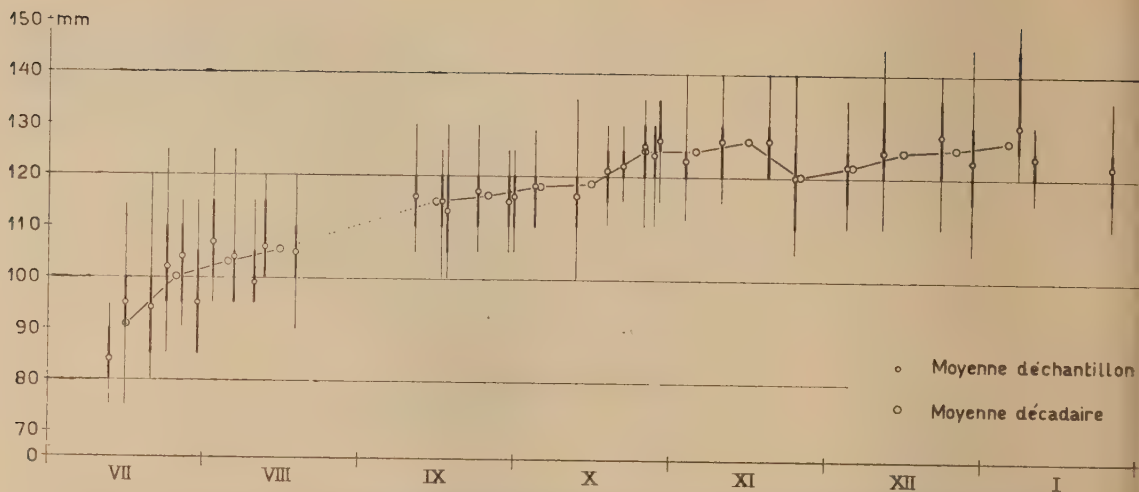


Figure 3. Croissance de la classe 0 de *Trachurus trachurus* depuis son apparition dans le produit de la pêche débarquée à Lisbonne. Les lignes verticales représentent l'amplitude de variation de la taille; les parties plus fines de ces lignes correspondent à des fréquences, par classes de demi-centimètre, inférieures à 10% du total dans chaque échantillon.

l'étude de la classe 0. Celle-ci est apparue en abondance et très régulièrement dans le produit de la pêche des bateaux qui s'occupent de la pêche de la sardine à Lisbonne, depuis Juillet 1954 au moins, jusqu'au mois de Février 1955. Nous avons étudié, pendant cette période, 37 échantillons comprenant un total de 4,700 individus. Le résultat est résumé dans la Figure 3, où sont représentés non seulement les moyennes et les amplitudes de

variation de la taille (mesurée jusqu'à la fourche de la caudale, égale à 0.92 de la longueur totale, caudale comprise) mais aussi les moyennes par décades.

La classe 0 semble donc croître très rapidement jusqu'à la fin d'Octobre (taille moyenne 125 mm.), après quoi il n'y a presque pas d'accroissement appréciable jusqu'à la fin de Janvier.

A. M. RAMALHO et J. S. PINTO.

Shellfish.

INTRODUCTION

Contributions have been received from A. DANNEVIG, G. D. WAUGH, P. KORRINGA (4) and P. F. MEYER-WAARDEN.

In the papers by KORRINGA and WAUGH a survey is given of the production and setting of oyster larvae in relation to environmental conditions. Owing to the low water temperature larval development was poor, and in the Dutch oyster districts the spatfall was a complete failure. The results in the English rivers, the Crouch and the Roach, seem to have been less disappointing. In both the English and Dutch oyster districts the number of flagellates was not less than normal during larval

development, despite the lack of sunshine and the low temperature.

In this issue figures are published for the first time on the quality of marketable oysters and mussels cultivated in the Netherlands; it is intended to continue the collection of these figures in the years to come. In addition some figures are given concerning the chemical and biological conditions of the water on the Dutch oyster grounds.

Both MEYER-WAARDEN and KORRINGA show some regression of *Mytilicola* in the western part of the German and the eastern part of the Dutch Waddensea.

B. HAVINGA.

CRUSTACEA

Annual Catches of Lobster during a long Period in a Norwegian District.

On the coast between Kragerø and Lista we have collected for many years precise information on the lobster catches of, in all, 25 to 30 fishermen. Table 1 gives the number of lobsters above 21 cm. per gear used.

The number of lobsters per gear is much higher in the eastern than in the western district. Weather conditions were extremely bad this year in the western part of the coast. The number of gear per fisherman is higher in the western than in the eastern part. The

Table 1.

Average	Jomfruland- Risør	Arendal- Ulvøysund	Skogsøy- Lista
1928—39.....	10.0	5.8	3.2
1940—49.....	14.6	6.5	4.3
1950.....	13.8	6.9	4.1
1951.....	14.0	7.6	4.4
1952.....	8.7	6.2	4.6
1953.....	9.1	6.9	3.5
1954.....	11.3	7.2	2.6

number caught in 1954 does not vary considerably from earlier years.

A. DANNEVIG.

MOLLUSCA

Oyster.

Production and Setting of Oyster Larvae in the Rivers Roach and Crouch during 1954.

Despite the spell of very cold weather at the beginning of February, which resulted in considerable ice formation, losses of oysters during the winter season were light. The average mortality on the shallow up-river grounds was approximately 16%. The low temperatures persisted for several days but when the thaw set in they rose rapidly so that though salinities at Fambridge dropped to below 20‰ for 3 days at this time, the oysters were never exposed to the combined effects of prolonged low salinity and low temperature.

During the summer the weather was abnormally cold (Figure 1). Rainfall was slightly greater than average, totalling 202 mm. for the period 1st June to 14th September, compared with a normal figure of approximately 180 mm. for the same period. Sunshine averaged only 4.7 hours per day during June, July and August compared with a mean of 7.2 hours (1949 to 1952) and the previous lowest of 5.7 hours per day in 1953.

This lack of sunshine, associated with low temperature conditions did not have such a marked effect on the flagellate population as was expected, though the mean daily water temperature in the river Roach only exceeded 18°C. for a total of 13 days during June, July and August.

Larval production.

There was a large scale liberation of oyster larvae on 21st June at which time the water temperature had reached 18°C. In the preceding 14 days the temperature had fluctuated between 15° and 16°C. so that spawning must have taken place at a temperature level lower than normal in Essex. The first larvae, which appeared on 10th June, must have been spawned at temperatures of between 14.5° and 15.5°C.

At the beginning of June, following a procedure adopted in 1953, the local oystermen were informed of the spatfall prospects and it was then stated that in view of the low temperatures and absence of larvae no spatfall of any magnitude could be expected, at least until towards the end of June. On 24th June

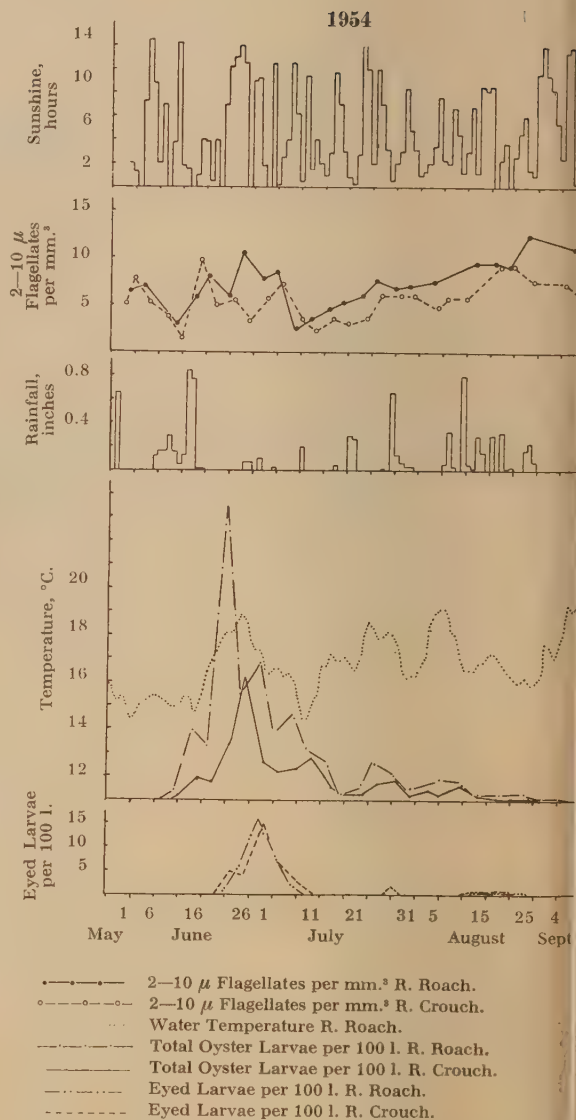


Figure 1. Showing the mean daily water temperature at Paglesham in the river Roach, the total numbers of larvae per 100 litres, the numbers of eyed larvae per 100 litres and production of 2-10 μ flagellates in the rivers Crouch and Roach. Also sunshine and rainfall at Burnham during the 1954 breeding season.

they were informed that small numbers of larvae liberated in the middle of the month were growing and that it was expected that the large numbers of larvae just liberated would

yield a moderate spatfall, the density of which would depend on the water temperature. Growth had been slow and the drop in temperature which occurred immediately afterwards retarded development. It took between 8 and 10 days for the larvae to grow to the eyed stage, so that they were exposed to predators and dispersion for a longer period than usual and it was expected that the proportion surviving to settlement would be small (KORRINGA, 1941). In fact, the percentage of larvae reaching the eyed stage and the spatfall were better than in the preceding three years, but were nevertheless insufficient to augment materially the stocks of oysters.

Feeding conditions, based on the numbers of 2–10 μ flagellates available, were relatively good and so compensated to a certain extent for the adverse temperatures. Further, the larvae themselves were probably more viable as they were produced from stocks of oysters which were in better condition than in the past few years.

Spatfall.

In 1953 the spatfall in the river Crouch was most intense on the down-river grounds but in 1954 it was rather more dispersed. In earlier years the spatfall had been heaviest in the middle and upper reaches of the river. Counts of spat on "clocks" from different localities were made in the same way as in previous years (WAUGH 1954) and the average numbers of spat per shell calculated. Results for the past three years are tabulated below:—

	Ground	Average numbers of spat per shell		
		1952	1953	1954
River Roach	Broadrakes	—	0.4	1.6
	Common Shore.....	0.8	—	0.2
	Shop Laying.....	1.7	2.8	2.3
River Crouch	Fambridge.....	0.2	0.4	0.6
	Purleigh Shore.....	0.05	—	1.2
	Creeksea	2.3	4.2	0.5
	Bush Shore.....	—	9.9	2.1

Despite the bigger numbers of larvae ready to settle, the spatfall on shells was of the same order or slightly less than in 1953. On egg-box collectors, on the other hand, spatfall was almost twice as great in the Crouch and of the same order as 1953 in the river Roach. It appeared, therefore, that the spatfall had been only slightly more intense than in 1953, though eyed larvae were approximately 3 $\frac{1}{2}$ times as abundant. In 1953, as an aftermath of the floods, there was considerable deposition of

silt on all grounds and it was concluded that the apparently anomalous settlement of oyster spat was due to the fact that surfaces suitable for settlement were less common than usual and the spatfall on them was, therefore, proportionately more intense. It is of interest that KORRINGA (1954) also observed anomalies in the Oosterschelde in 1953 where conditions were similar.

Nanoplankton.

Though the amount of sunshine was considerably reduced during 1954, the population of 2–10 μ flagellates was fairly dense and for most of the season fluctuated between 5 and 10 per mm³. Populations of more than 5 per mm³ seem to be sufficient for growth of larvae and, in view of the low temperatures, which have the effect of reducing the larval feeding rate, there was an adequate food supply.

In both rivers the population followed a similar pattern, responding, in part, to fluctuations in water temperatures. However, on 21st June, at the time of the peak liberation of oyster larvae in the river Roach, there was a drop in the flagellate numbers, followed by an increase, as the numbers of oyster larvae fell. In the river Crouch peak numbers of larvae appeared on 24th June and there was again a drop in the flagellate population, though at this time the numbers were increasing in the river Roach. Similar observations have been made in previous years and it would appear that such reductions in the numbers of flagellates are due to the grazing of oyster larvae.

Experiments on the use of inorganic enrichment were continued in the upper Crouch and the detailed results will be published elsewhere. It was found that the addition of phosphate resulted in a slight increase in the flagellate population but phosphate concentration was already high and increased during turbulent conditions. From the results now available it appears unlikely that phosphate alone will produce very great rises in the flagellate population of the rivers Crouch and Roach.

G. D. WAUGH.

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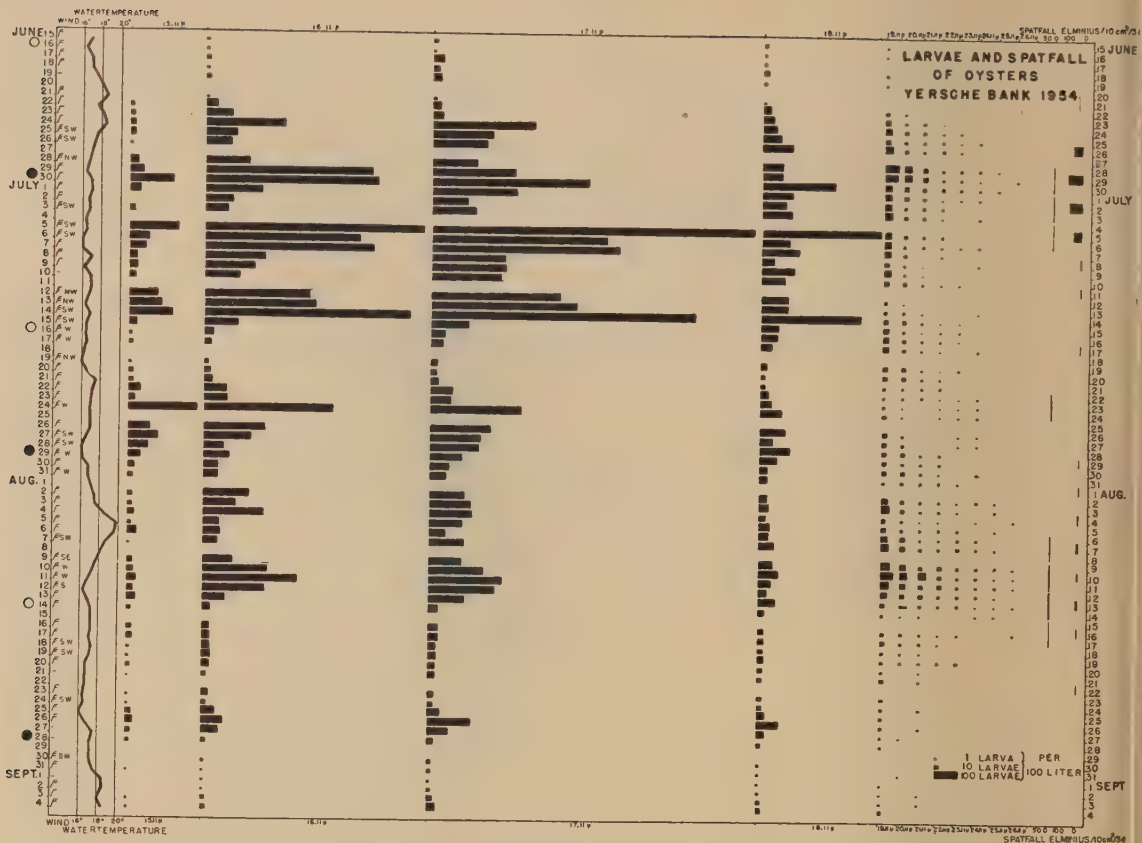


Figure 2.

Larvae and Spatfall of Oysters in the Oosterschelde (Holland) in the Year 1954.

To assist our oystermen in their efforts to produce oyster spat at a low price, we continued our observations on the number and size of oyster larvae in the water of the Oosterschelde in 1954. The methods used in collecting and dealing with our samples have been described previously. The samples were again collected at the Yersche Bank station in the centre of the Basin of the Oosterschelde. Daily samples were taken at high slack water from 15. June up to 19. June inclusive. Twice daily samples were taken at high slack and low slack water in the height of the season from 21. June up to 18. August inclusive. From 19. August up to 4. September, inclusive, daily samples have been collected at high slack water. It was impossible to collect plankton samples on Sundays when our boats stayed in port. When two plankton samples were taken in a day, the average number of

larvae in each size-class has been computed for 100 litres, and is shown in the diagram. The intensity of setting was measured in the usual way by exposing 3 lime-coated glass slides, measuring 13×18 cm., at angles of 45° in a concrete container for periods of 3 days. The average number of spat per slide is shown in Figure 2. We continued collecting data on the setting of *Elminius modestus* DARWIN on our spatfall slides. The average number of *Elminius* setting on 10 cm.² of slide (5 cm.² upper surface plus 5 cm.² lower surface) per period of 3 days has been shown in Figure 2. *Elminius* may have settled in appreciable numbers prior to 25. June and later than 4. September.

Our prediction bulletins, also broadcast by radio, ran as follows:— In the general outlook—based on the steadily increasing oyster stock and on the good condition of the oysters—an ample production of larvae was predicted which could only in an abnormally cold sum-

mer lead to a disappointing settlement of spat on the collectors. The first peak in the production of larvae which could be of practical importance, was according to lunar periodicity to be expected about 27. June, but the greatest numbers of larvae could be expected about a fortnight later.

On 18. June very small numbers of larvae were reported to occur in the Oosterschelde at a water temperature of only about 17° C. On 24. June it was recorded that the number of larvae had increased considerably, but the water temperature being only 18° C. umbo larvae were rare and "mature" larvae being absent, no spatfall was yet to be expected. A further increase in the number of larvae was reported on 28. June but water temperatures being low and larval development being very slow, no setting could be predicted. On 30. June it was said that about 1000 oyster larvae occurred per 100 litres of water, the first peak in the production of larvae apparently having been of considerable importance. Water temperatures being as low as 17° C. larval development was said to be extremely slow. The occurrence of an occasional "mature" larva indicated that the setting of the first spat, decidedly not of commercial importance, would occur shortly. Continuous low temperatures and slow larval development were recorded on 5. July. On 7. July it was said that water temperatures had dropped to 16° C., that oyster larvae were very abundant, but so slow was their development that umbo and "mature" larvae were almost lacking, so that setting could not occur at all. The bulletins issued on 12., 15., 19., and 27. July informed the oystermen that water temperatures fluctuated between 16 and 17° C., which led to an almost complete standstill of larval development. Notwithstanding the enormous numbers of oyster larvae produced in the first half of July, setting would not occur, not even a setting of minor importance.

On 3. August it was stated that weather conditions were improving, but that the temperature of the water had not yet reached the 18° C. level considered critical for larval development. The number of larvae still being worth mentioning, improvement of setting prospects could still occur. A further increase in water temperature and in larval development was reported on 6. August. The number of larvae still being reasonable, a spatfall of modest importance was predicted for the

week to come, provided weather conditions remained favourable. On 10. August the water temperature had, however, dropped again below the 18° C. level through cold and rough weather. There being quite a few umbo and "mature" larvae at that time it was hoped that some spatfall would occur, despite the bad weather. This outlook was confirmed on 12. August. On 19. August it was reported that the number of larvae had dropped below 100 per 100 litres of water, that umbo and "mature" larvae were rare, and that water temperatures were low, so that spatfall would have come to a complete standstill. Observations were continued up to 4. September, inclusive, but no further bulletins were issued for spatfall prospects did not improve.

It can be seen from Figure 2 that the measured intensity of setting agreed well with our predictions. The total production of larvae has indeed been very great, despite the cold and rough weather. It exceeded slightly that of the years 1953 and 1952, which tallies with the steadily increasing stock of adult oysters. The first peak in larval production occurred from 27. to 29. June, slightly retarded through low water temperatures. The greatest numbers of larvae made their appearance from 5. July up to 14. July. This apparently was the great annual maximum, though of a more diffuse nature than in previous years. Minor peaks in larval production occurred about 25. July, about 10., and 26. August, following the lunar periodicity pattern.

It is noteworthy that the newly liberated larvae were of a slightly larger size (the 17.11 μ group being more numerous than the 16.11 μ group) than in previous years with higher water temperatures.

Larval development was extremely poor in 1954. This can be ascribed to unusually low water temperatures. The number of flagellates (over 5,000/cc.) being rather higher than lower in the summer of 1954 when compared with other years, lack of food cannot have been responsible for the very disappointing season. Water temperatures below 17½° C. evidently slow down larval development so much that very few larvae reach the umbo stage. "Mature" larvae and setting were completely absent during the period of water temperatures under 17° C. Only a sprinkling of spat settled on the collectors in the periods 28. June to 6. July, 22. to 24. July, and 6. to 17. August, all of them following slight in-

creases in water temperature. The setting following the only major peak in water temperature—early in August—was poorer than we anticipated from the reasonable number of umbo and “mature” larvae recorded. Evidently rough weather and a rapidly dropping water temperature exerted a fatal influence.

Water temperatures as low as those which prevailed in the month of July 1954 are very unusual indeed in the Oosterschelde. The average temperature here, is 18.7° for the first, and 19.5° C. for the second part of July and we have to go back to the year 1922 to find a month of July with water temperatures comparable to those of 1954. The number of days with stormy weather was also excessively great in the summer of 1954.

The year 1954 confirms our view that the number of oyster larvae produced does not depend on yearly fluctuations in summer temperature, neither does the phenomenon of lunar periodicity. Low water temperatures do slow down larval development, and if continuously below 17° C. spatfall will be stopped completely.

Commercially the 1954 spatfall season was a complete failure. The tiles put in the water late in June and early in July, in spite of the poor setting prospects indicated by our bulletins, caught a mere sprinkling of spat. A great number of tiles was kept ashore in the hope that setting prospects would improve in the second part of July or even early in August. Unfortunately continuation of the rough and cold weather dashed these hopes. The tiles put out in spite of the bad weather caught little if any spat, those immersed shortly after 6. August being the best, but bearing rarely over 10 spat per tile. So few spat was found on most of the tiles later in the season (e.g., less than 5 per tile) that many oystermen decided it would not pay to look after these young oysters through the successive stages of rearing. Therefore about 2/3 of the tiles were brought ashore in autumn, so that only few were transferred to the wintering pits. Such procedure had not been witnessed since we started our predicions in 1936.

The mussel shells scattered as collectors (about 7,500 m.³) also met with complete failure in 1954. Though requiring considerably less labour than the tile-collectors, the financial losses suffered in scattering shells in 1954 are not negligible, the price of the shells being about Hfl. 15.— per m.³ plus the costs for planting the shells on the beds.

The setting of *Elminius modestus* was of lesser importance than in 1952, but exceeded that in 1953. In the period 26. June to 5. July setting of *Elminius* was rather intensive; a limited number settled in the middle of August. Water temperature does not seem to be the major factor in success or failure of *Elminius*’ setting, at least not above the 10° C level as would follow from the heavy settings in the months of May.

P. KORRINGA.

The Quality of Marketable Oysters from the Zealand Waters in 1954.

The stock of oysters in the Oosterschelde (Holland) has increased gradually and already approaches the figure of 100,000,000 oysters of 2 years and older which in the past gave reason for concern (KORRINGA, 1947). Too big a population density on the beds in the Basin of the Oosterschelde led in the past repeatedly to complaints about poor growth, poor quality, and excessive losses. It has, however, not been established that undernutrition was the causative factor.

In their efforts to attain an optimal quality of the marketable oysters year after year our oystermen want to receive advise on the necessity to plant oysters on grounds outside the Basin of the Oosterschelde—even if higher losses are to be expected there—now that overpopulation may threaten in the Basin itself. In the spring of 1954 we began with experimental planting of oysters outside the Basin of the Oosterschelde on a fair scale.

To follow the results of these efforts and to gain more information on annual and local fluctuations in the quality of the marketable oysters, we collected samples in November and December—after completion of fattening, but before the usual spring decline—and measured the quality of these oysters. The quality has been expressed as a condition index: 1000 x the dry weight of the meat in g. divided by the volume of the shell cavity in cm.³. The methods to determine dry weight and shell cavity have been described previously (KORRINGA, 1955). It so happens that an index of 100 indicates oysters of good quality, 110 very good, and 120 exceptionally fat oysters. Oysters with an index of 90 are still reasonably good, those of 80 lean, and 70 indicates very poor oysters indeed. The figures obtained have been charted (Figure 3). Indices over



Figure 3.

100 are indicated as sectors in solid black, beginning at the 0° line—indicating 100—and covering $\frac{1}{4}$ circle for every 25 points over 100. Indices under 100 are indicated as hatched sectors, $\frac{1}{4}$ circle being 25 points under 100. The map is very instructive and shows that the quality of the oysters of several experimental plantings outside the Basin of the Oosterschelde was very promising.

In the Basin itself we note marked differences, though all the oysters could be classified as "good" in this propitious year. The best oysters are found in the central part of the Yerseche Bank: from plot 350 to plot 328, fanning out to 220-333-389 further on. This excellent area covers a great number of plots where the best marketable oysters are grown. That the higher grounds of the Yerseche Bank (e.g., 270, 183, 180) though not, or rarely, exposed at low tide, and also the plots on the NE. edge of this Bank (e.g., 359a, 356) show

lower condition indices tallies very well with the practical experience of the oystermen. Also that the results are not that good on the deep plots in the eastern part of the Basin (e.g., 417, 472, 510), but very good on plot 380 near the Isle of Tholen.

It is our intention to produce similar maps, if possible in greater detail in the years to come, and it would certainly be welcomed if similar data could be collected in other districts where *Ostrea edulis* is grown to marketable size.

Unfortunately we are but very poorly informed on the factors governing the quality of the oysters and bringing about local and annual fluctuations. As far as local differences go, it seems very probable that our oystermen are right in supposing that the type and cleanliness of the bottom is of considerable importance, but other factors should not be overlooked.

To gain more insight in the biological conditions prevailing on the Yersche Bank in the centre of the Oosterschelde in 1954 we analysed weekly samples of water taken at high slack and low slack water about 1 m. above the bottom. The data thus obtained are a good starting point for further investigations, for 1954 was in many respects an unusual year: growth and quality of the oysters were very satisfactory though the summer was unusually cold (water temperatures above 18° C. occurred on a few days only), rough weather prevailed, and salinities were much higher than usual (30 to 32 ‰, while 27.75 ‰ is a normal average). This latter is the more surprising as influx of some fertile fresh water is as a rule considered of paramount importance in bringing about good fattening conditions. Sunshine, so important for phytoplankton production, was subnormal for the entire second half of the year. Phosphates fluctuated from 0.15 µg. at./l. in spring to about 0.60 µg.at./l. in mid-winter, total phosphorus, on the other hand, remained remarkably constant throughout the year (1.5 to 2.0 µg.at./l. of which some 0.5 µg.at. appeared to belong to the plankton or detritus, the remainder being either truly dissolved or in a very finely dispersed state. Some 5 mg. of KMnO_4 were necessary to break down the more labile organic matter in 1 litre of water (6 mg. in May, 4 mg. in November) of which only about 1 mg. could be ascribed to plankton, detritus or other readily settling matter. The phytoplankton showed considerable fluctuations in the course of the year. In the main period of oyster fattening (i.e., September, October) it ranged from 1 to 2 mg. chlorophyll/m³. Both small flagellates (about 5,000/cm.³ in summer, 2,000/cm.³ in autumn) and the phytoplankton organisms of such a big size that they could be caught with the 60 µ meshed plankton net always constituted only a minor fraction of the total phytoplankton.

The investigations will be continued concurrently with observations on the quality of the oysters in the hope that we will in the long run be able to point out which hydrographical and biological factors are responsible for annual and local fluctuations in the quality of the oysters. Similar information from other oyster districts would be very welcome indeed.

P. KORRINGA.

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Mussel.

The Quality of Marketable Mussels from the Dutch Waddensea in 1954.

The establishment of the parasitic copepod *Mytilicola intestinalis* in the Zealand waters dealt a severe blow to the local mussel industry. Up to 1950 the Zealand waters produced some 40 to 50 million kg. of marketable mussels annually. Practical experience gained in several consecutive years has fully confirmed my view (KORRINGA, 1950) that it is possible to continue the cultivation of mussels in the Zealand waters in the presence of *Mytilicola*, provided one aims at a more modest annual production. The number of mussels grown in a given body of water is indeed a factor of considerable importance in the epidemiology of *Mytilicola*. The Zealand mussels, renowned for their quality and flavour, kept their place on the markets of western Europe, though the annual production had to be reduced to some 15 to 18 million kg. per year. Every effort to raise the production to higher levels has been punished severely by *Mytilicola* outbreaks, which seriously reduced the quality of the mussels. The Zealand mussel farmers, not satisfied with such a limited production, made an effort to raise the quantity of marketable mussels to the former high level by starting the cultivation of mussels in the western part of the Waddensea, still completely free of *Mytilicola*. Up to 1950 the production of marketable mussels in the Waddensea had been of limited importance only, though extensive beds existed there, from which mussels were fished for relaying in Zealand and for sale to duck farms elsewhere in the Netherlands. Many experimental plots were created in the deeper parts of the Waddensea after 1950, and huge quantities of mussels from the natural beds on the higher grounds were planted there. On an average the results were very promising, indeed, and soon a great number of plots were used on a commercial scale. Thus the total production of marketable mussels reached its old level again, even surpassed that recently. In the season 1954—

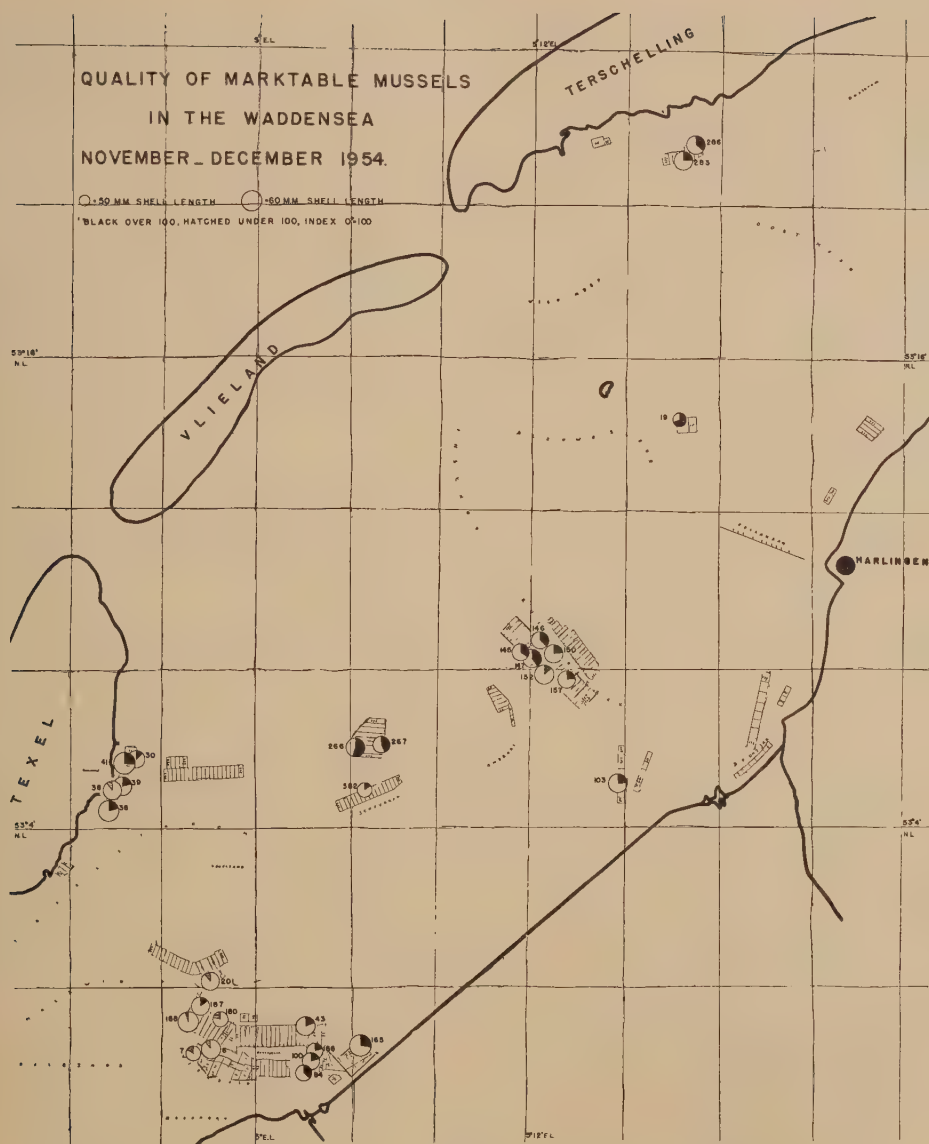


Figure 4.

1955 18,100,000 kg. of marketable mussels were sold from the Zealand waters (predominantly of good quality) plus 44,500,000 kg. from the Waddensea.

It is hoped to continue mussel farming in the Waddensea on this scale. This will only be possible if sufficient quantities of mussels for relaying can be harvested on the local natural beds—free of *Mytilicola*—and if the mussels continue to grow and fatten well

on the new plots. Experienced mussel farmers claim that they often observe a decline in the quality of the mussels on plots which initially yielded very good mussels. They therefore fear that it may be difficult to keep quality and productivity in the western Waddensea at the present high level.

Though we do not yet know the reason for the decline in productivity of mussel plots, we decided to follow as closely as possible

the events in this very important new mussel district. To this end we measured the quality of mussel samples collected in November and December, after termination of the fattening season, and before the usual spring decline. The quality has been expressed as a condition index: 1000 x the dry weight of the meat in g. divided by the volume of the shell cavity in cm³. The methods to determine dry weight and shell cavity have been described previously (KORRINGA, 1955). The figures obtained have been charted (Figure 4). Indexes over 100 are indicated as sectors in solid black, beginning at the 0° line—indicating 100—and covering 1/4 circle for every 25 points over 100; indexes under 100 are indicated as hatched sectors, 1/4 circle being 25 points under 100.

The map shows very clearly that the quality of the mussels varies considerably from place to place.

We hope to continue this work in the years to come in order to get an insight in the annual and local fluctuations in the quality of the mussels, and in the hope of finding in the long run the reasons for the changes observed.

P. KORRINGA.

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Mytilicola intestinalis in the German Waddensea, 1954.

The *Mytilicola* disease has probably passed its climax in the east Friesian Waddensea area. In all areas investigated in 1954 the number of infested animals was below that of the previous year (Table 2).

Table 2.

	Area of Borkum		Area of Norderney		Area of Wangerooge	
	Attack %	Aver. No. per infest. mussel	Attack %	Aver. No. per infest. mussel	Attack %	Aver. No. per infest. mussel
1951.....	79.2	4.4	80.2	7.2	—	—
1952.....	94.0	6.2	84.5	6.0	—	—
1953.....	83.0	9.4	95.4	8.6	73.2	5.7
1954.....	72.0	5.0	60.0	7.4	45.3	4.8

In the spring of 1955 a decreasing trend could also be observed, as the investigations made in February 1955 proved for the Bor-

kum area. While in March 1954 in the Randzel area—Westerbalje and off Norderney an infection with an average of 97 % (94—100 %) and 10 (8.9—11.5) parasites per attacked mussel had been found, the infection in the same area in February 1955 was 68 % (60—80 %) and 3 (2.2—4.3) parasites per infected mussel on average. Future developments will show whether the decreasing trend will continue during 1955; when the swarming time of the *Mytilicola* larvae is finished, the new infection can be examined.

In the Waddensea area of Schleswig-Holstein—west coast—the *Mytilus* population continued to be unaffected.

P. F. MEYER-WAARDEN.

Epidemiological Observations on the Mussel Parasite *Mytilicola intestinalis* STEUER, carried out in the Netherlands 1954.

Waddensea.

That the western part of the Dutch Waddensea is nowadays of vital importance for our mussel industry is clearly demonstrated by the figures for the production of marketable mussels in the season 1954—1955: 44,500,000 kg. came from the Waddensea, i.e., 71 % of the total production in the Netherlands.

We made a search for *Mytilicola intestinalis* in a great number of samples from the plots in the western part of the Waddensea but failed to find it there. Apparently these waters are still completely free of this obnoxious parasite. As danger may threaten from the east (KORRINGA, 1953, 1954) we kept the transition area under control. In the winter of 1953—1954 we found an occasional *Mytilicola* on the natural beds between the islands of Ameland and Schiermonnikoog (Figure 5a) but too few to believe in a self-supporting centre of distribution which might threaten the districts further west with invasion. The occurrence of a male and a female *Mytilicola* in one and the same mussel was evidently very rare (cf. KORRINGA, 1953). A great number of samples taken somewhat further west—beyond the limits of Figure 5—in the waters south of the isle of Ameland, which get their tidal supply of water almost exclusively through the Borndiep—which is to the NW.—failed to reveal the presence of *Mytilicola* there. Evidently it were the outposts of the eastern *Mytilicola* population

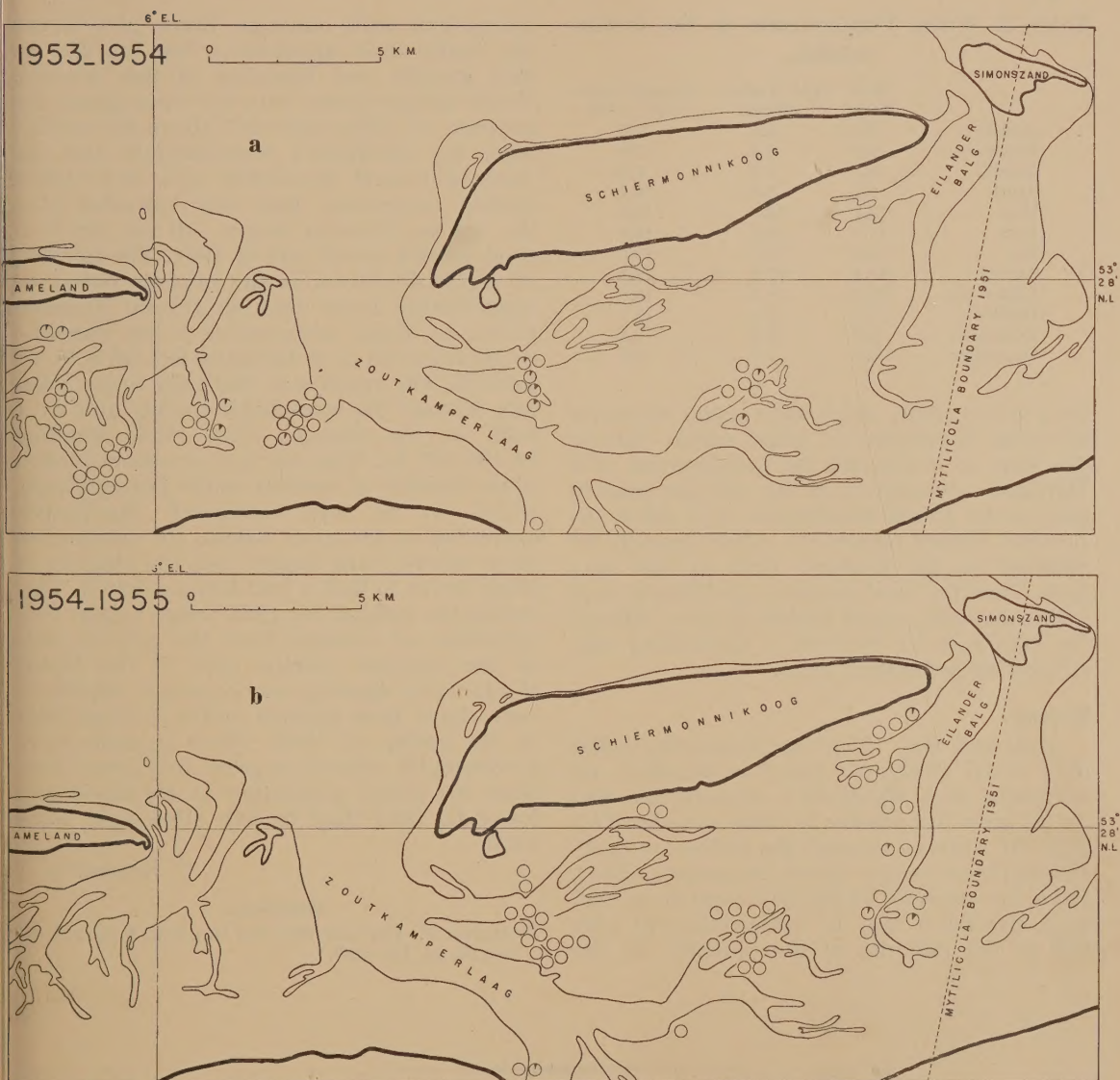


Figure 5a. Waddensea 1953—1954. Percentage of mussels infested by *Mytilicola intestinalis*.
Figure 5b. Waddensea 1954—1955. Percentage of mussels infested by *Mytilicola intestinalis*.

which were found in the area between the isles of Ameland and Schiermonnikoog. Again the boundary was situated further west than in 1951 (KORRINGA, 1953).

Samples collected in the winter of 1954—1955 (Figure 5 b) revealed a slight regression of *Mytilicola* in the transition area. Only very few *Mytilicola* larvae found their way through the Zoutkamperlaag to the natural beds situated south of the isle of Schiermonni-

koog. This noticeable regression demonstrates that the adult *Mytilicola* die off before they are a year old, even if they remain virgin as is evidently the case in very light infestations. Some more *Mytilicola* were found on the natural beds of the Eilander Balg, but here also the amount of production of larvae was negligible.

Despite this regression we consider it necessary to keep an eye on the transition area in

Table 3. Water Temperatures in the Oosterschelde.

	1954 Basin	1954 Western district	Average Basin 1921—1939
January	3.4	4.1	3.0
February	0.5	0.4	2.9
March	4.5	4.2	4.9
April	8.1	8.6	8.5
May	12.7	13.4	13.3
June	17.0	15.3	16.9
July	16.6	16.7	19.0
August	17.4	17.6	18.8
September	16.2	16.1	16.6
October	12.7	13.5	12.1
November	9.0	10.0	7.1
December	6.7	7.3	3.6

the years to come, and to take action whenever alarming developments might occur. One of the ways to counteract the development of a *Mytilicola* population in the extreme eastern part of the Dutch Waddensea is to allow the Zealand mussel farmers to collect mussels for relaying on the Zealand beds in this very area. Thus the local mussel population is kept within bounds, which makes it more difficult for *Mytilicola* to establish a flourishing self-supporting population there.

Zealand.

April and May 1954 were somewhat colder than usual (Table 3) and it is therefore not surprising that *Mytilicola*'s reproduction was not of great importance in these months. This gave the Zealand mussels the chance we anticipated in an earlier report (KORRINGA, 1954). Even the mussels which had been in a very poor condition late in 1953 recovered after loss of the majority of the parasites in late

spring and early summer. Some new larvae did make their appearance but too few to stop growth and fattening of the mussels. Water temperatures were low throughout the summer of 1954—but well above the critical level for *Mytilicola*'s reproduction—and the Zealand mussel population was of a rather modest magnitude, and well spreaded over the various Zealand waters. All this led to a good mussel season late in 1954. The number of *Mytilicola* found in the mussels remained considerably lower than in several previous years—in many cases under 5 per mussel—so that growth and fattening left little to be desired. The result was that very many mussels reached the marketable quality and were sold in the season 1954—1955, totalling 18,100,000 kg. This led to a serious reduction of the number of mussels on the Zealand beds, which in its turn hampered *Mytilicola*'s spreading to no small extent, the production of its larvae being limited and the chances of these larvae to find a host being reduced. This makes the outlook for 1955 rather bright. Fair quantities of mussels from the natural beds in the extreme eastern part of the Dutch Waddensea—bearing an occasional *Mytilicola* only—have been planted on the Zealand beds in the spring of 1955. These mussels have a reasonable chance to grow and fatten well, since the initial population of *Mytilicola* was lower in 1955 than in any other year since 1950.

P. KORRINGA.

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